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Forest Service

North Central Forest Experiment Station

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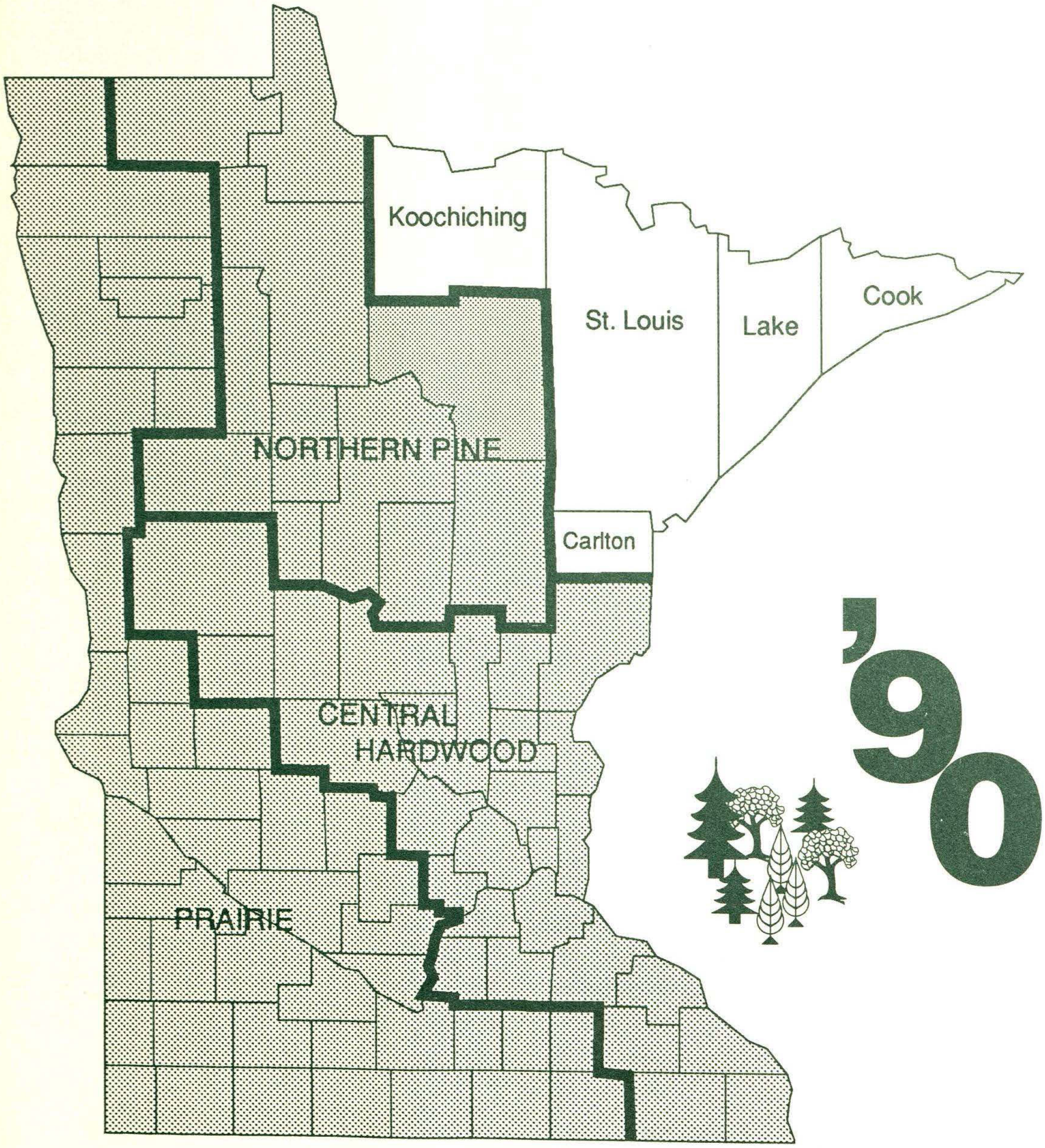
Forest Statistics for Minnesota's
Aspen-Birch Unit

Neal P. Kingsley


Koochiching
St. Louis
Lake
Cook
Carlton
NORTHERN PINE
CENTRAL HARDWOOD
PRAIRIE

'90

This report includes the most commonly used Forest Inventory and Analysis statistics. However, additional forest resource data can be provided to interested users. Persons requesting additional information that can be provided from the raw inventory data are expected to pay the retrieval costs. These costs range from less than $100 for a relatively simple request to $2,000 for a complex retrieval involving the services of a Forest Inventory and Analysis computer programmer. Requests will be filled so as to minimize the impact on the Forest Inventory and Analysis Work Unit.

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FOREWORD

Forest Inventory and Analysis (FIA) is a continuing endeavor as mandated by the Renewable Forest and Rangeland Resources Planning Act of 1974. Prior inventories were mandated by the McSweeney-McNary Forest Research Act of 1928. The objective of FIA is to periodically inventory the Nation's forest land to determine its extent, condition, volume of timber, growth, and removals. Up-to-date resource information is essential to frame forest policies and programs. USDA Forest Service regional experiment stations are responsible for conducting these inventories and publishing summary reports for individual States. The North Central Forest Experiment Station is responsible for forest inventory and analysis in Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, South Dakota, and Wisconsin.

Fieldwork for the Minnesota Aspen-Birch Unit forest inventory was begun in May 1986 and completed in February 1990. Reports of four previous inventories of Minnesota's timber resource are dated 1936, 1953, 1962, and 1977.

More accurate survey information was obtained during this survey than otherwise would have been feasible because of intensified field sampling. Such sampling was made possible through the cooperation and assistance of the Minnesota Department of Natural Resources (MDNR). Data for the Aspen-Birch Unit were collected by contract crews hired and supervised by the MDNR. To aid in determining current timber removals, the MDNR also surveyed primary wood-using plants in the State.

Aerial photos used in the Aspen-Birch Unit forest inventory were purchased by the State from U.S. Geological Survey. This photography was from the National High Altitude Photography program (NHAP). In addition, MDNR provided 35mm true color prints at a scale of 1:15,840 of all of the 1977 plot locations for disturbance detection.

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Forest Statistics For Minnesota's Aspen-Birch Unit

Neal P. Kingsley

HIGHLIGHTS

NOTE: *Data from new forest inventories are often compared with data from earlier inventories to determine trends in forest resources. However, for the comparisons to be valid, the procedures used in the two inventories must be similar. As a result of our ongoing efforts to improve the efficiency and reliability of the inventory, several changes in procedures and definitions have occurred since 1977. Because some of these changes will make it inappropriate to directly compare the 1990 data with those published for 1977, data from the 1977 inventory have been reprocessed using the 1990 procedures. Please refer to the section labeled "Comparing Minnesota's Fifth Inventory With the Fourth Inventory" for more details.* ***The data in this report are subject to change when inventory data for the entire State have been compiled. It is expected, however, that any such changes will be minor.***

General

The Aspen-Birch Geographic Sampling Unit consists of five counties in extreme northeastern Minnesota (see cover). This is the most heavily forested region of the State. Originally it supported a nearly pure coniferous forest of eastern white pine, red pine, jack pine, black spruce, white spruce, balsam fir, tamarack, and northern white-cedar. Logging and fires, however, have drastically altered the character of the forest. Today the Aspen-Birch Unit is generally dominated by hardwoods and by aspen in particular.

Forest Area

- The Aspen-Birch Unit contains 8.7 million acres of land, of which 7.4 million acres are forested. Two of the Unit's counties—Cook and Lake—are more than 90 percent forested.

- Total forest land in the Unit has declined 1.4 percent since 1977.

- Nearly 80 percent—5.9 million acres—of the forest land in the Unit is classified as timberland. This is forest land that is capable of or is producing 20 cubic feet or more of industrial wood crops and is not withdrawn from timber harvesting. Between 1977 and 1990, area of timberland in the Unit increased 442,300 acres.

- Nearly two-thirds—3.9 million acres—of the Unit's timberland is in public ownership (fig. 1). The largest owner, with more than 1,331.3 thousand acres, is the State of Minnesota, followed by the Superior National Forest with 1,253.9 thousand acres and county and municipal governments with 1,234.4 thousand acres. Of the 2.0 million acres that is privately owned, 900.5 thousand acres are held by miscellaneous individuals. Forest industries own 462.3 thousand acres. The area of farmer owned timberland stands at 206.5 thousand acres, down from 540.4 thousand in 1977.

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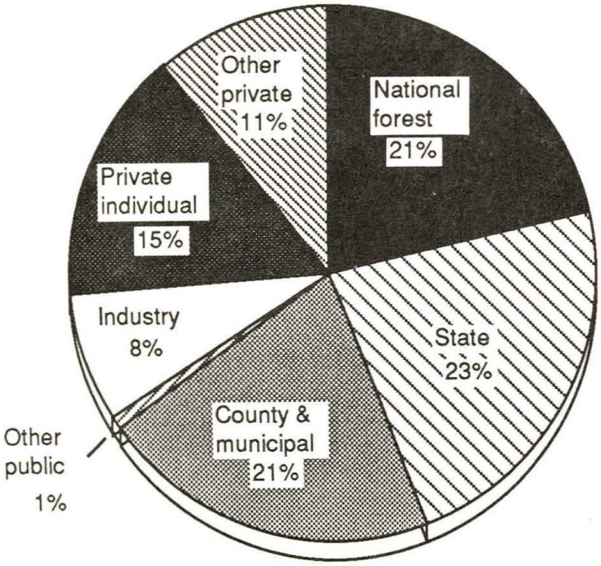

Figure 1.—*Distribution of timberland in the Aspen-Birch Unit by ownership class, 1990.*

- Although this five-county region has 14 different forest types, the aspen type dominates the landscape (fig. 2). Nearly 34 percent of the timberland—2 million acres—is in the aspen type. This is nearly the same percentage as in 1977. The second most abundant type is black spruce with 943.2 thousand acres, just over 16 percent of the timberland. The areas of both black spruce and tamarack timberland have increased since 1977. Nearly all of this increase can be attributed to the fact that some areas classified as unproductive in 1977 were classified as marginally productive in 1990.

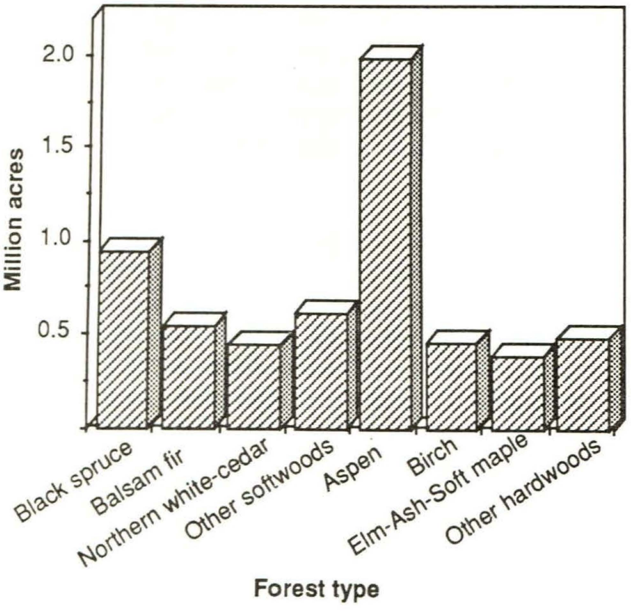

Figure 2.—*Area of timberland in the Aspen-Birch Unit by forest type, 1990.*

- Although the area of sawtimber size stands has increased 476.2 thousand acres since 1977, poletimber and seedling-sapling stands still dominate the Unit. These two stand-size classes account for 73 percent of the timberland. This reflects the fiber oriented forest economy of the region and the prevalence of clearcutting as a method of regenerating stands.

Volume

- The volume of timber in the Aspen-Birch Unit totals more than 5.6 billion cubic feet, 954 cubic feet per acre. This is an increase of 21 percent since 1977.
- Aspen accounts for nearly half of the 3.1 billion cubic feet of hardwood growing stock in the Unit (fig. 3). Black spruce and balsam fir account for nearly 47 percent of the 2.5 billion cubic feet of softwoods.

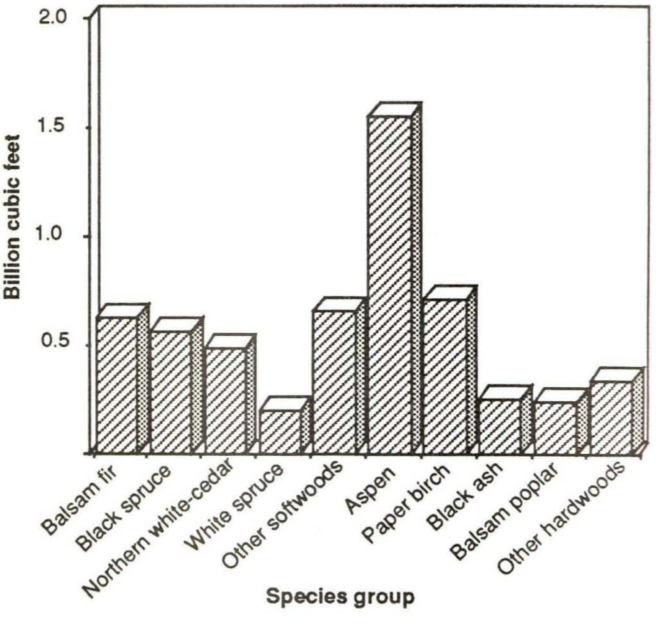

Figure 3.—*Volume of growing stock on timberland in the Aspen-Birch Unit by species group, 1990.*

- Sawtimber volume in the Aspen-Birch Unit stands at nearly 11.9 billion board feet, up from 8.3 billion in 1977.

- The Superior National Forest contains nearly 1.4 billion cubic feet of growing stock, nearly evenly divided between softwoods (688 million cubic feet) and hardwoods (670 million cubic feet) (fig. 4). Volume per acre on the National Forest is 1,083 cubic feet. The second largest holders of timber are county and municipal governments, with 1.2 billion cubic feet.

- Volume per acre on county and municipal lands averages 991 cubic feet per acre, of which about 64 percent is hardwood. State lands hold 1.1 billion cubic feet, about 842 cubic feet per acre. Forty percent of the volume on State lands is hardwood. This reflects the fact that much of the State land is in poor wet sites, which often contain slow growing black spruce and tamarack.

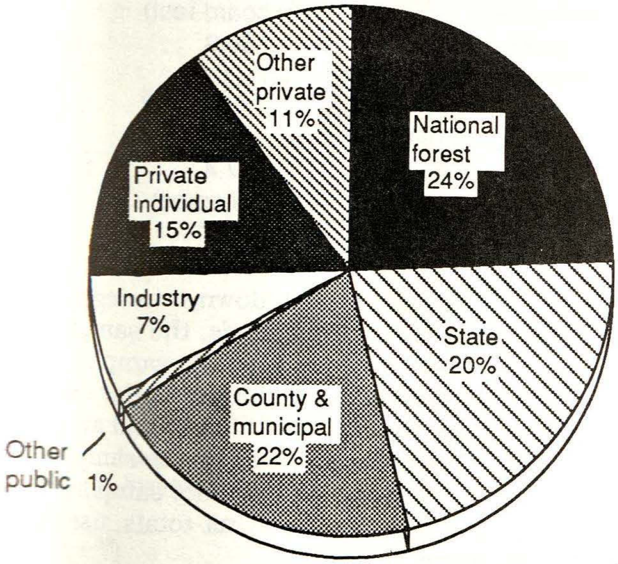

Figure 4.—*Distribution of growing-stock volume on timberland in the Aspen-Birch Unit by ownership class, 1990.*

Timber Growth, Mortality, and Removals

- Net annual growth of growing stock on timberland averaged 132.1 million cubic feet per year from 1977 through 1989 (fig. 5). This is an average of 22 cubic feet per acre per year, or 2 percent of the average inventory during the period.

- Softwood growth averaged 55.8 million cubic feet, or 2.2 percent of the softwood inventory. Hardwood growth averaged 76.4 million cubic feet, or 2.5 percent of the hardwood inventory.

- Mortality of growing stock averaged 82.8 million cubic feet per year from 1977 through 1989.

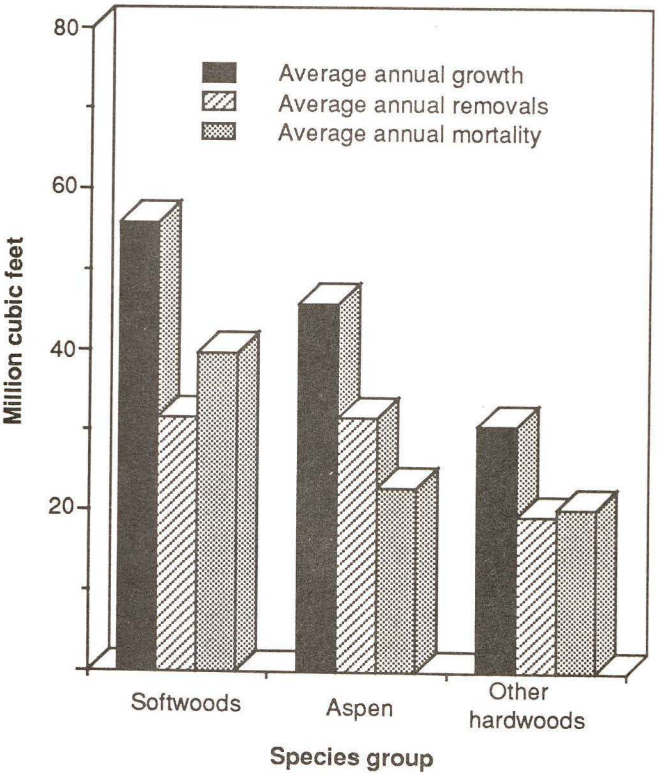

Figure 5.—*Average annual growing-stock growth, removals, and mortality on timberland in the Aspen-Birch Unit by species group, 1977-1989.*

- Average annual removals of growing stock from timberland was 82.7 million cubic feet per year from 1977 through 1989. This is 63 percent of average net annual growth.
- Softwood removals for the period averaged 31.7 million cubic feet. Hardwood removals averaged 51.1 cubic feet per year.
- Aspen growth averaged 45.9 million cubic feet from 1977 through 1989. Removals of aspen averaged 31.7 million cubic feet per year. However, in 1989, aspen growth in the Aspen-Birch Unit was 49.3 million cubic feet and removals was 55.1 million.
- Current annual growth of growing stock on timberland was 149.3 million cubic feet in 1989. This is an average of 25.4 cubic feet per acre per year, or 2.7 percent of the current inventory.
- Removals of growing stock on timberland in 1989 stood at 102.4 million cubic feet—69 percent of current annual growth.

APPENDIX

ACCURACY OF THE SURVEY

Forest Inventory and Analysis information is based on a sampling procedure designed to provide reliable statistics at the State and Survey Unit levels. Consequently, the reported figures are estimates only. A measure of reliability of these figures is given by sampling errors. These sampling errors mean that the chances are two out of three that if a 100-percent inventory had been taken, using the same methods, the results would have been within the limits indicated.

For example, the estimated growing-stock volume in the Unit in 1990, 5,608.3 million cubic feet, has a sampling error of ±1.08 percent (±60.6 million cubic feet). The growing-stock volume from a 100-percent inventory would be expected to fall between 5,547.7 and 5,668.9 million cubic feet (5,608.3 ± 60.6), there being a one in three chance that this is not the case.

The following tabulation shows the sampling errors for the Aspen-Birch Forest Inventory:

Item	Unit totals	Sampling error
Growing stock:	(Million cubic feet)	(Percent)
Volume (1990)	5,608.3	1.08
Average annual growth (1977-1989)	132.1	1.88
Average annual removals (1977-1989)	82.7	10.08
Sawtimber:	(Million board feet)	
Volume (1990)	11,866.8	1.69
Average annual growth (1977-1989)	440.3	2.21
Average annual removals (1977-1989)	177.4	14.22
Timberland	(Thousand acres)	
Area (1990)	5,878.7	0.57

As survey data are broken down into segments smaller than Survey Unit totals, the sampling error increases. For example, the sampling error for timberland area in a particular county is higher than that for total timberland area in the Unit. This tabulation shows the sampling errors for Unit totals. To estimate sampling error for data smaller than Unit totals, use the following formula:

$$\text{Error} = \frac{(\text{SE})\sqrt{(\text{Unit total area or volume})}}{\sqrt{(\text{Volume or area smaller than Unit total})}}$$

where:

E = sampling error in percent
SE = Unit total error for area or volume

For example, to compute the error on the area of timberland in the elm-ash-soft maple in the Unit, proceed as follows:

The total area of elm-ash-soft maple type in the Unit from table 3 = 387,800 acres

The total area of all timberland in the Unit from table 3 = 5,878,700 acres

The Unit total error for timberland area from the above tabulation = 0.57 percent

Using the above formula:

$$\text{Error} = \frac{(0.57)\sqrt{5{,}878{,}700}}{\sqrt{387{,}800}}$$

$$= \pm 2.22 \text{ percent}$$

SURVEY PROCEDURES

The 1990 Minnesota survey used a growth model enhanced, two-phase sample design. Using this sampling scheme and associated estimators is similar to sampling with partial replacement (SPR), in that a set of randomly located plots is available for remeasurement and a random set of new plots is established and measured. A significant feature of the new Minnesota design is stratification for disturbance on the old sample and use of a growth model to improve regression estimates made on old undisturbed forest plots (fig. 6). Detailed descriptions of the sampling and estimation procedures are presented by Hansen (1990)[1]. The growth model used in the Minnesota survey design was the Lake States Stand and Tree Evaluation and Modeling System (STEMS)[2].

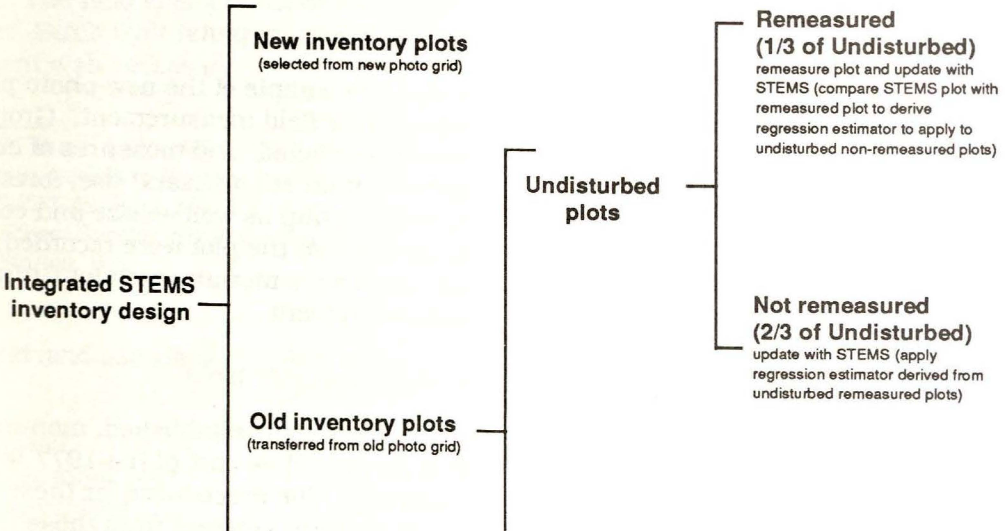
Integrated STEMS inventory design
New inventory plots
(selected from new photo grid)
Old inventory plots
(transferred from old photo grid)
Undisturbed plots
Disturbed plots
remeasure plot
Remeasured
(1/3 of Undisturbed)
remeasure plot and update with STEMS (compare STEMS plot with remeasured plot to derive regression estimator to apply to undisturbed non-remeasured plots)
Not remeasured
(2/3 of Undisturbed)
update with STEMS (apply regression estimator derived from undisturbed remeasured plots)

Figure 6.—*Overview of the Minnesota sample design.*

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[1] *Hansen, Mark H. 1990. A comprehensive sampling system for forest inventory based on an individual tree growth model. St. Paul, MN: University of Minnesota, College of Natural Resources. 256 p. Ph.D. dissertation.*

[2] *Belcher, David W.; Holdaway, Margaret R.; Brand, Gary J. 1982. A description of STEMS the Stand and Tree Evaluation and Modeling System. Gen. Tech. Rep. NC-79. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station. 18 p.*

These were the major steps in the new survey design:

1. Aerial photography (Phase 1)

In this phase two sets of random points were located on current aerial photography. The first is a set of new photo plots and the second is a set of relocated old ground plot locations from the 1977 inventory. Photos were 1:58,000 scale color infrared National High Altitude Photo program (NHAP) prints purchased by the Minnesota Department of Natural Resources (MDNR) from the U.S. Geological Survey. In addition, MDNR provided 35mm true color prints at a scale of 1:15,840 of all of the 1977 ground plot locations. These 35mm prints were used in addition to the NHAP prints to help detect disturbances in the 1977 ground plot locations. The year of photography for each county in the Unit is shown below.

	Date	
County	**NHAP**	**35mm**
Carlton	1981	1986-87
Cook	1984	1986-87
Koochiching	1981	1986-87
Lake	1981-84	1986-87
St. Louis	1981	1986-87

The locations of the plots used in the 1977 inventory were transferred to these new photographs. The photographs were then assembled into township mosaics, and a systematic grid of 121 one-acre photo plots (each plot representing approximately 190.4 acres) was overlaid on each township mosaic. Each of these photo plots was examined by aerial photogrammetrists and classified stereoscopically based on land use. If trees were present, forest type and stand-size density class were recorded. All of the 1977 ground plot locations were also examined for disturbance (logging, fire, catastrophic mortality, etc.) with the aid of the 35mm photography. After this examination, all the old '*disturbed*' sample locations, a one-third sample of the old '*undisturbed*' sample locations, and a sample of the new photo plots were sent to the field for survey crews to verify the photo classification and to take further measurements. In all, 44,562 new photo plots and 4,956 ground plot locations from the 1977 inventory were examined for the Aspen-Birch Unit and were classified as shown in the following tabulation.

Photo land class	**Photo plots**
Timberland	28,387
Reserved forest land	5,403
Other forest land	3,441
Questionable	1,310
Nonforest with trees	911
Nonforest without trees	6,671
Water	3,395
All classes	49,518

2. Plot measurements (Phase 2)

On plots classified as timberland, wooded pasture, or windbreak (at least 120 feet wide), a ground plot was established, remeasured, or modeled. Old plots sent to the field for remeasurement that could not be relocated were replaced with a new plot at the approximate location of the old one. Each ground plot consists of a 10-point cluster covering approximately 1 acre. At each point, trees 5.0 inches or more in d.b.h. were sampled on a 37.5 Basal Area Factor (BAF) variable-radius plot, and trees less than 5.0 inches d.b.h. were sampled on a 1/300-acre fixed-radius plot. The measurement procedure for the new and old sample locations was as follows:

a. New inventory plots

A random sample of the new photo plots was selected for field measurement. Ground plots were established, and measures of current classification such as land use, forest type, and ownership as well as size and condition of all trees on the plot were recorded. These locations were monumented for future remeasurement.

b. Old inventory plots

These plots were established, monumented, and measured as part of the 1977 field inventory. The procedures for these old plot locations were different from those for the new plots. Old plots were classed as '*undisturbed*' or '*disturbed*' in the aerial photo phase of the sampling process. All disturbed plots and a one-third sample of the undisturbed plots were remeasured to obtain estimates of current condition and changes since the last inventory. All trees measured on these plots in 1977 were remeasured or otherwise accounted for, and all new trees were identified and measured.

All sample plots that were forested at the time of the 1977 inventory and determined to be undisturbed until this inventory were projected to the current time using STEMS. This procedure gives projected estimates of current volume and growth for these undisturbed plots. The comparison of the projected and observed values on the one-third sample of the undisturbed forest plots that were remeasured provided local calibration data to adjust the projected values of the undisturbed plots that were not remeasured. The adjustment procedure is a modified version of the method described by Smith[3].

The old sample plots that were not forested in 1977 and were determined to be undisturbed until the current inventory (no evidence of conversion to another land use) were also sub-sampled (field checked) at the one-third rate. Any changes in land use to forest detected on these plots were used to adjust the two-thirds sample of these plots not field checked. The field check of these points in the Aspen-Birch Unit indicated that no adjustment was necessary.

The undisturbed plots that were not remeasured play a crucial role in the new survey design. These plots, after careful examination comparing past and current aerial photography, were determined to be undisturbed and had conditions that could be simulated by STEMS. The STEMS growth model was used to "grow" the old plot and tree data to produce an estimate of current data. Thus, these plots were treated as ground plots, even though they were never visited. The plot record for each modeled plot was sent to the field for verification of current ownership information.

All old plots classified as disturbed were sent to the field for remeasurement to assess and verify changes since the last inventory. Disturbance refers to any change on a plot that can be detected on aerial photos and that the STEMS growth processor cannot predict, such as catastrophic mortality, cutting, seedling stands, and land use change.

The estimation procedure for computing statistics from this sampling design was more complicated than the simple two-phase estimation procedure used in the past. In fact, this procedure yielded two independent samples, one coming from the new photo points and the other from the old photo points that are remeasured or modeled. The following tabulation summarizes the distribution of all ground plots for the new inventory design by type of plot:

Ground land use class	Old plots remeasured	Old plots updated	Old plots replaced	New plots	Total plots
Timberland	2,573	841	8	1,460	4,882
Reserved forest land	13	16	0	537	566
Other forest land	74	290	1	83	448
Nonforest with trees	50	3	0	22	75
Nonforest without trees	344	357	24	217	942
Water	128	233	1	236	598
Total	3,182	1,740	34	2,555	7,511

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[3] *Smith, W. Brad. 1983. Adjusting the STEMS regional growth models to improve local predictions. Res. Note NC-297. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station. 5 p.*

3. Area estimates

Area estimates were made using two-phase estimation methods. In this type of estimation, a preliminary estimate of area by land use is made from the aerial photographs (Phase 1) and corrected by the plot measurements (Phase 2). A complete description of this estimation method is presented by Loetsch and Haller (1964)[4].

Area estimates within the Superior National Forest were determined in the same way as other lands but were verified by comparison with National Forest compartment examination records maintained by the Forest Timber Management Staff. This is an intensive area inventory system in which, over a period of years, each stand in the Forest is mapped on aerial photographs and then classified by ground visits.

4. Volume estimates

Estimates of volume per acre were made from the trees measured or modeled on the 10-point plots. Estimates of volume per acre were multiplied by the area estimates to obtain estimates of total volume. Net cubic foot volumes are based on a modification of the method presented by Hahn (1984)[5] for use in the Lake States. For the Minnesota inventory, the merchantable height equation presented was used in conjunction with Stone's equation to estimate gross volume. This estimate was then corrected by species for variation in bark and cull volume to yield an estimate of net volume.

The Forest Service reports all board foot volume in International 1/4-inch rule. In Minnesota, the Scribner log rule is commonly used. Scribner log rule conversion factors were derived from full tree measurements taken throughout the Lake States (Michigan, Wisconsin, and Minnesota) and an equation developed by Wiant and Castenaeda (1977)[6]. The factors (multipliers) used here to convert board foot International volumes to the Scribner rule are shown in the following tabulation:

D.B.H.	**Scribner rule conversion factor**	
(inches)	**Softwoods**	**Hardwoods**
9.0-10.9	0.7830	--
11.0-12.9	0.8287	0.8317
13.0-14.9	0.8577	0.8611
15.0-16.9	0.8784	0.8827
17.0-18.9	0.8945	0.8999
19.0-20.9	0.9079	0.9132
21.0-22.9	0.9168	0.9239
23.0-24.9	0.9240	0.9325
25.0-26.9	0.9299	0.9396
27.0-28.9	0.9321	0.9454
29.0+	0.9357	0.9544

5. Growth and mortality estimates

On remeasured plots, estimates of growth and mortality per acre come from the remeasured diameters of trees and from observation of trees that died between inventories. Growth reported as the average net annual growth between the two inventories (1977 and 1990) is computed from data on remeasurement plots and modeled plots using methods presented by VanDeusen *et al.* (1986)[7]. Mortality is also average net annual for the remeasurement period. On new plots, where trees were not remeasured, estimates of growth and mortality were obtained by using STEMS to project the growth and mortality of trees for 1 year. Growth and mortality estimates for old undisturbed plots that were updated were derived in the same manner as remeasured plots. The STEMS growth model was adjusted by Survey Unit to meet local conditions, using data from the undisturbed remeasurement plots. As with volume, total growth and mortality estimates were obtained by multiplying the per acre estimates by area estimates. Current annual growth for 1989 was computed by using the adjusted STEMS model to grow all current inventory plots for 1 year.

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[4] *Loetsch, F.; Haller, K.E. 1964. Forest inventory, volume 1, statistics of forest inventory and information from aerial photographs. BLV Verlagsgesellschaft Munch Basle Vienna. 436 p.*

[5] *Hahn, Jerold T. 1984. Tree volume and biomass equations for the Lake States. Res. Pap. NC-250. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station. 10 p.*

[6] *Wiant, Harry V., Jr.; Castenaeda, Froylan. 1977. Mesavage and Girard's volume tables formulated. BLM4. Denver, CO: U.S. Department of Interior, Bureau of Land Management, Denver Service Center: 1-4.*

[7] *VanDeusen, P.C.; Dell, T.R.; Thomas, C.E. 1986. Volume growth estimation from permanent horizontal points. Forest Science. 32: 415-422.*

6. Average annual removals estimates

Average annual growing-stock and sawtimber removals (1977 to 1989) were estimated only from the remeasured plots; new plots were not used to estimate removals. These estimates are obtained from trees measured in the last survey and cut or otherwise removed from the timberland base. Because remeasurement plots make up about one-half of the total ground plots, average annual removals estimates have greater sampling errors than volume and growth estimates.

COMPARING MINNESOTA'S FIFTH INVENTORY WITH THE FOURTH INVENTORY

The following paragraphs highlight some of the procedural changes since the last inventory to assist the reader in analyzing data from this report:

A new volume estimation procedure was developed for the Lake States (see Survey Procedures section), and this procedure was used to compute the 1989 volumes and also to recompute the 1977 volume for growth calculations. Although the adjustment will differ by Survey Unit and species, the recomputed 1977 growing-stock and board foot volumes will generally be greater than those shown in the 1977 report.

Mortality figures published in the 1977 inventory report were based on field estimates of the number of trees that died in the 3 years before the inventory. Information gathered on remeasurement plots during the current inventory was used to adjust the 1977 mortality figures. This adjustment will also affect the estimate of net growth for the 1977 inventory.

Past surveys used only growing-stock trees to determine stand-size class. Current survey procedures require that stand-size class be determined on the basis of all live trees. Therefore, direct comparisons of current inventory data to old inventory data by stand-size class may be misleading.

The basic building block for estimating forest area and timber volume has been changed from the Survey Unit to the county. In the past, the statistics were developed at the Unit level and prorated back to the county on the basis of photo-interpretation points. Direct development of county-level data helps users interested in more precise local data, but can make the outcome of comparisons with past estimates uncertain.

LOG GRADE

In Minnesota the butt log of every sawtimber sample tree was graded for quality on approximately one-third of the sample plots. The volume yield by log grade for species in this sample was used to distribute the volume of trees in the ungraded sample into log-grade classes by species group.

Logs were graded on the basis of external characteristics as indicators of quality. Hardwood species were graded according to "A guide to hardwood log grading"[8]. The best 12-foot section of the lowest 16-foot hardwood log, or the best 12-foot upper section if the butt log did not meet minimum log-grade standards, was graded as follows:

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[8] *Rast, Everette D.; Sonderman, David L.; Gammon, Glenn L. 1973. A guide to hardwood log grading. Gen. Tech. Rep. NE-1. Upper Darby, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 31 p.*

Forest Service standard grades for hardwood factory saw logs

Grading Factors		Specifications							
		Log grade 1			**Log grade 2**				**Log grade 3**
Position in tree		Butts only	Butts & uppers		Butts & uppers				Butts & uppers
Scaling diameter, inches		13-15[1]	16-19	20+	11+[2]	12+			8+
Length without trim, feet		10+			10+	8-9	10-11	12+	8+
Required clear cuttings[3] of each of three best faces[4]	Min. length, feet	7	5	3	3	3	3	3	2
	Max. number		2	2	2	2	2	3	No limit
	Min. proportion of log length required in clear cutting	5/6	5/6	5/6	2/3	3/4	2/3	2/3	1/2
Maximum sweep & crook allowance	For logs with less than one-fourth of end in sound defects	15 percent			30 percent				50 percent
	For logs with more than one-fourth of end in sound defects	10 percent			20 percent				35 percent
Maximum scaling deduction		40 percent[5]			50 percent[6]				50 percent

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[1] *Ash and basswood butts can be 12 inches if they otherwise meet requirements* for small #1's.

[2] *Ten-inch logs of all species can be #2 if they otherwise meet requirements for small #1's.*

[3] *A clear cutting is a portion of a face, extending the width of the face, that is free of defects.*

[4] *A face is one-fourth of the surface of the log as divided lengthwise.*

[5] *Otherwise #1 logs with 41-60 percent deductions can be #2.*

[6] *Otherwise #2 logs with 51-60 percent deductions can be #3.*

Forest Service standard specifications for hardwood construction logs (tie and timber logs)[1]

Position in tree	Butts and uppers
Min. diameter, small end	8 inches +
Min. length without trim	8 feet
Clear cuttings	No requirements
Sweep allowance	One-fourth of the diameter at the small end for each 8 feet of length.
Sound surface defects:	
Single knots	Any number, if no one knot has an average diameter above the callus in excess of one-third of the log diameter at point of occurrence.
Whorled knots	Any number, if the sum of knot diameters above the callus does not exceed one-third of the log diameter at point of occurrence.
Holes	Any number, provided none has a diameter over one-third of the log diameter at point of occurrence and none extends more than 3 inches into included timber[2]
Unsound surface defects :	Same requirements as for sound defects if they extend into included timber. No limit if they do not.

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[1] *These specifications are minimum for the class. If, from a group of logs, factory logs are selected first, thus leaving only nonfactory logs from which to select construction logs, then the quality range of the construction logs so selected is limited, and the class may be considered a grade. If selection for construction logs is given first priority, it may be necessary to subdivide the class into grades.*

[2] *Included timber is always square, and dimension is judged from small end.*

LOG GRADES FOR EASTERN WHITE PINE

Log grade	Minimum size[1] Diameter	Minimum size[1] Length	Sweep or crook allowance	Total cull allowance including sweep	Maximum weevil injury	Allowable knot size (inches)[2] on three best faces or minimum clearness on four faces
	(Inches)	*(Feet)*	*(Percent)*	*(Percent)*	*(Number)*	*(Inches)*
1	12 & 13	8-16	20	50	0	Four faces clear full length
	14+	10-16	20	50	0	Two faces clear full length, or four faces clear 50 percent length (6 feet min. length)[3]
2	6+	8-16	30	50	0	Sound knots l.e[4] D/6 and less than 3 inches[5] Unsound knots: l.e.1-1/2 inches and for: butt, logs l.e. D/12 upper logs l.e.D/10, or four faces clear 50 percent of length
3	6+	8-16	40	50	8-foot logs: 1 weevil 10-foot+ logs: 2 weevils	Sound knots l.e.D/3 and less than 5 inches Unsound knots l.e. D/6 and less than 2-1/2 inches
4	6+	8-16	50	50	No limit	No limit

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[1] *Plus trim.*

[2] *Disregard all knots less than 1/2-inch diameter in all grades.*

[3] *The sum of the diameter of sound knots plus twice the sum of the diameter of unsound knots (in inches) is less than or equal to half of the diameter of the log (inches).*

[4] *l.e. means less than or equal to.*

[5] *D means d.i.b. of log at location of knot.*

LOG GRADES FOR JACK PINE AND RED PINE

Grade 1: Logs with three or four clear faces.[1]

Grade 2: Logs with one or two clear faces.

Grade 3: Logs with no clear faces.

After the tentative log grade is established from above, the log will be degraded one grade for each of the following, except that no log can be degraded below grade 3. Net scale after deduction for defect must be at least 50 percent of the gross contents of the log.

1. *Sweep.* Degrade any tentative 1 or 2 log one grade if sweep amounts to 3 or more inches and equals or exceeds one-third of the diameter inside bark at small end.

2. *Heart rot.* Degrade any tentative 1 or 2 log one grade if conk, massed hyphae, or other evidence of advanced heart rot is found anywhere in it.

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[1] *A face is one-fourth of the circumference in width extending full length of the log. Clear faces are those free of: knots measuring more than 1/2-inch in diameter, overgrown knots of any size, and holes more than 1/4-inch in diameter. Faces may be rotated to obtain the maximum number of clear ones.*

LOG GRADES FOR ALL OTHER SOFTWOOD LOGS

Grade 1

1. Logs must be 16 inches in diameter or larger, 10 feet in length or longer, and with deduction for defect not over 30 percent of gross scale.
2. Logs must be at least 75 percent clear on each of three faces.
3. All knots outside clear cutting must be sound and not more than 2-1/2 inches in size.

Grade 2

1. Logs must be 12 inches in diameter or larger, 10 feet in length or longer, and with a net scale after deduction for defect of at least 50 percent of the gross scale deducted for defect.
2. Logs must be at least 50 percent clear on each of three faces or 75 percent clear on two faces.

Grade 3

1. Logs must be 6 inches in diameter or larger, 8 feet in length or longer, and with a net scale after deduction for defect of at least 50 percent of the gross contents of the log.

Note: *A) Diameters are diameter inside bark (d.i.b.) at small end of log.*
B) Percent clear refers to percent clear in one continuous section.

METRIC EQUIVALENTS OF UNITS USED IN THIS REPORT

1 acre = 4,046.86 square meters or 0.405 hectare.
1,000 acres = 405 hectares.
1 cubic foot = 0.0283 cubic meter.
1 foot = 30.48 centimeters or 0.3048 meter.
1 inch = 25.4 millimeters, 2.54 centimeters, or 0.0254 meter.
1 pound = 0.454 kilograms.
1 ton = 0.907 metric tons.

TREE SPECIES GROUPS IN MINNESOTA[9]

SOFTWOODS	
Eastern white pine	*Pinus strobus*
Red pine	*Pinus resinosa*
Jack pine	*Pinus banksiana*
White spruce	*Picea glauca*
Black spruce	*Picea mariana*
Balsam fir	*Abies balsamea*
Tamarack	*Larix laricina*
Northern white-cedar	*Thuja occidentalis*
Other softwoods	
Eastern redcedar	*Juniperus virginiana*
Scotch pine	*Pinus sylvestris*
HARDWOODS	
Select white oak[10]	
White oak	*Quercus alba*
Bur oak	*Quercus macrocarpa*
Select red oak[10]	
Northern red oak	*Quercus rubra*
Other red oaks	
Northern pin oak	*Quercus ellipsoidalis*
Black oak	*Quercus velutina*
Hickory[10]	
Shagbark hickory	*Carya ovata*
Bitternut hickory	*Carya cordiformis*
Hard maple[10]	
Black maple	*Acer nigrum*
Sugar maple	*Acer saccharum*
Soft maple[11]	
Red maple	*Acer rubrum*
Silver maple	*Acer saccharinum*
Ash[10]	
Black ash	*Fraxinus nigra*
Green ash	*Fraxinus pennsylvanica*
Balsam poplar[11]	*Populus balsamifera*
Aspen	
Bigtooth aspen[11]	*Populus grandidentata*
Quaking aspen[11]	*Populus tremuloides*
Cottonwood[11]	*Populus deltoides*
Basswood[11]	*Tilia americana*
Black walnut[10]	*Juglans nigra*
Black cherry[11]	*Prunus serotina*
Butternut[11]	*Juglans cinerea*
Elm	
American elm[11]	*Ulmus americana*
Slippery elm[11]	*Ulmus rubra*
Rock elm[10]	*Ulmus thomasii*
Hackberry[11]	*Celtis occidentalis*
Black willow[11]	*Salix nigra*
Other hardwoods	
Boxelder[11]	*Acer negundo*
Black locust[10]	*Robinia pseudoacacia*
Red mulberry[11]	*Morus rubra*
Honeylocust[10]	*Gleditsia triacanthos*
Northern catalpa[10]	*Catalpa speciosa*
Noncommercial species	
Eastern hophornbeam	*Ostrya virginiana*
Apple	*Malus* spp.
American hornbeam	*Carpinus caroliniana*
Wild plum	*Prunus* spp.
Hawthorn	*Crataegus* spp.

DEFINITION OF TERMS

Average annual removals from growing stock.—The average net growing-stock volume in growing-stock trees removed annually for forest products (including roundwood products and logging residues) and for other uses (see Other removals). Average annual removals of growing stock are reported for a period of several years (1977 to 1989 in this report) and are based on information obtained from remeasurement plots (see Survey Procedures in Appendix).

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[9] *The common and scientific names are based on: Little, Elbert L. 1979. Checklist of native and naturalized trees of the United States. Agric. Handb. 541. Washington, DC: U.S. Department of Agriculture, Forest Service. 385 p.*

[10] *This species or species group is considered a hard hardwood, with an average specific gravity greater than or equal to 0.50.*

[11] *This species or species group is considered a soft hardwood, with an average specific gravity of less than 0.50.*

Average annual removals from sawtimber.—The average net board foot sawtimber volume of live sawtimber trees removed annually for forest products (including roundwood products and other uses [see Other removals]). Average annual removals of sawtimber are reported for a period of several years (1977 to 1989 in this report) and are based on information obtained from remeasurement plots (see Survey Procedures in Appendix).

Commercial species.—Tree species presently or prospectively suitable for industrial wood products. (Note: Excludes species of typically small size, poor form, or inferior quality such as hophornbeam, osage-orange, and redbud.)

Commercial forest land.—(See Timberland).

Cord.—One standard cord is 128 cubic feet of stacked wood, including bark and air space. Cubic feet can be converted to standard cords by dividing by 79.

County and municipal land.—Land owned by counties and local public agencies or municipalities, or land leased to these governmental units for 50 years or more.

Cull.—Portions of a tree that are unusable for industrial wood products because of rot, missing or dead material, or other defect.

Current annual growth of growing stock.—The annual change in volume of sound wood in live sawtimber and poletimber trees and the total volume of trees entering these classes through ingrowth, less volume losses resulting from natural causes. Current growth is reported for a single year (1989 in this report) and based on an estimate of the current annual increment of each growing stock tree in the inventory.

Current annual growth of sawtimber.—The annual change in the volume of live sawtimber trees and the total volume of trees reaching sawtimber size, less volume losses resulting from natural causes. Current growth is reported for a single year (1989 in this report) and based on an estimate of the current annual increment of each growing stock tree in the inventory.

Current annual removals from growing stock.—The current net growing-stock volume in growing-stock trees removed annually for forest products (including roundwood products and logging residues) and for other uses (see Other removals). Current annual removals of growing stock are reported for a single year (1988 in this report) and are based on a survey of primary wood processing mills to determine removals for products and information from remeasurement plots (see Survey Procedures in Appendix) to determine removals due to land use change.

Current annual removals from sawtimber.—The current net board foot sawtimber volume of live sawtimber trees removed annually for forest products (including roundwood products and other uses [see Other removals]). Current annual removals of sawtimber are reported for a single year (1988 in this report) and are based on a survey of primary wood processing mills to determine removals for products and information from remeasurement plots (see Survey Procedures in Appendix) to determine removals due to land use change.

Diameter class.—A classification of trees based on diameter outside bark, measured at breast height (d.b.h.). Two-inch diameter classes are commonly used in Forest Inventory and Analysis, with the even inch the approximate midpoint for a class. For example, the 6-inch class includes trees 5.0 through 6.9 inches d.b.h.

Diameter at breast height (d.b.h.).—The outside bark diameter at 4.5 feet (1.37 m) above the forest floor on the uphill side of the tree. For determining breast height, the forest floor includes the duff layer that may be present, but does not include unincorporated woody debris that may rise above the ground line.

Farm.—Any place from which $1,000 or more of agricultural products were produced and sold during the year.

Farmer-owned land.—Land owned by farm operators whether part of the farmstead or not. (Note: Excludes land leased by farm operators from nonfarm owners, such as railroad companies and States.)

Forest land.—Land at least 16.7 percent stocked by forest trees of any size, or formerly having had such tree cover, and not currently developed for nonforest use. (Note: Stocking is measured by comparing specified standards with basal area and/or number of trees, age or size, and spacing.) The minimum area for classification of forest land is 1 acre. Roadside, streamside, and shelterbelt strips of timber must have a crown width of at least 120 feet to qualify as forest land. Unimproved roads and trails, streams, or other bodies of water or clearings in forest areas shall be classed as forest if less than 120 feet wide. (See Tree, Land, Timberland, Reserved forest land, Other forest land, and Stocking.)

Forest industry land.—Land owned by companies or individuals that operate a primary wood-using plant.

Forest type.—A classification of forest land based on the species forming a plurality of live tree stocking. Major forest types in the State are:

Jack pine.—Forests in which jack pine comprises a plurality of the stocking. (Common associates include eastern white pine, red pine, aspen, birch, and maple.)

Red pine.—Forests in which red pine comprises a plurality of the stocking. (Common associates include eastern white pine, jack pine, aspen, birch, and maple.)

White pine.—Forests in which eastern white pine comprises a plurality of the stocking. (Common associates include red pine, jack pine, aspen, birch, and maple.)

Balsam fir.—Forests in which balsam fir and white spruce comprise a plurality of stocking with balsam fir the most common. (Common associates include aspen, maple, birch, northern white-cedar, and tamarack.)

White spruce.—Forests in which white spruce and balsam fir comprise a plurality of the stocking with white spruce the most common. (Common associates include aspen, maple, birch, northern white-cedar, and tamarack.)

Black spruce.—Forests in which swamp conifers comprise a plurality of the stocking with black spruce the most common. (Common associates include tamarack and northern white-cedar.)

Northern white-cedar.—Forests in which swamp conifers comprise a plurality of the stocking with northern white-cedar the most common. (Common associates include tamarack and black spruce.)

Tamarack.—Forests in which swamp conifers comprise a plurality of the stocking with tamarack the most common. (Common associates include black spruce and northern white-cedar.)

Oak-hickory.—Forests in which northern red oak, white oak, bur oak, or hickories, singly or in combination, comprise a plurality of the stocking. (Common associates include jack pine, elm, and maple.)

Elm-ash-soft maple.—Forests in which lowland elm, ash, red maple, silver maple, and cottonwood, singly or in combination, comprise a plurality of the stocking. (Common associates include birches, spruce, and balsam fir.)

Maple-basswood.—Forests in which sugar maple, basswood, yellow birch, upland American elm, and red maple, singly or in combination, comprise a plurality of the stocking. (Common associates include white pine, elm, and basswood.)

Aspen.—Forests in which quaking aspen or bigtooth aspen, singly or in combination, comprise a plurality of the stocking. (Common associates include balsam poplar, balsam fir, and paper birch.)

Paper birch.—Forests in which paper birch comprises a plurality of the stocking. (Common associates include maple, aspen, and balsam fir.)

Growing-stock tree.—A live tree of commercial species that meets specified standards of size, quality, and merchantability. (Note: Excludes rough, rotten, and dead trees.)

Growing-stock volume.—Net volume in cubic feet of growing-stock trees 5.0 inches d.b.h. and over, from 1 foot above the ground to a minimum 4.0 inch top diameter outside bark of the central stem or to the point where the central stem breaks into limbs.

Hard hardwoods.—Hardwood species with an average specific gravity greater than 0.50 such as oaks, hard maple, hickories, and ash.

Hardwoods.—Dicotyledonous trees, usually broad-leaved and deciduous. (See Soft hardwoods and Hard hardwoods.)

Land.—A. *Bureau of the Census.* Dry land and land temporarily or partly covered by water such as marshes, swamps, and river flood plains (omitting tidal flats below mean high tide); streams, sloughs, estuaries, and canals less than one-eighth of a statute mile wide; and lakes, reservoirs, and ponds less than 40 acres in area.

B. *Forest Inventory and Analysis.* The same as the Bureau of the Census, except minimum width of streams, etc., is 120 feet and minimum size of lakes, etc., is 1 acre.

Log grade.—A log classification based on external characteristics as indicators of quality or value. (See Appendix for specific grading factors used.)

Marsh.—Nonforest land that characteristically supports low, generally herbaceous or shrubby vegetation and that is intermittently covered with water.

Merchantable.—Refers to a pulpwood or saw-log section that meets pulpwood or saw-log specifications, respectively.

Miscellaneous Federal land.—Federal land other than National Forest and land administered by the Bureau of Land Management or Bureau of Indian Affairs.

Miscellaneous private land.—Privately owned land other than forest-industry and farmer-owned land.

Mortality.—The volume of sound wood in growing-stock and sawtimber trees that die annually.

National Forest land.—Federal land that has been legally designated as National Forest or purchase units, and other land administered by the USDA Forest Service.

Net annual growth of growing stock.—The annual change in volume of sound wood in live sawtimber and poletimber trees and the total volume of trees entering these classes through ingrowth, less volume losses resulting from natural causes.

Net annual growth of sawtimber.—The annual change in the volume of live sawtimber trees and the total volume of trees reaching sawtimber size, less volume losses resulting from natural causes.

Net volume.—Gross volume less deductions for rot, sweep, or other defect affecting use for timber products.

Noncommercial species.—Tree species of typically small size, poor form, or inferior quality that normally do not develop into trees suitable for industrial wood products.

Nonforest land.—Land that has never supported forests, and land formerly forested where use for timber management is precluded by development for other uses. (Note: Includes areas used for crops, improved pasture, residential areas, city parks, improved roads of any width and adjoining clearings, powerline clearings of any width, and 1- to 40-acre areas of water classified by the Bureau of the Census as land. If intermingled in forest areas, unimproved roads and nonforest strips must be more than 120 feet wide and more than 1 acre in area to qualify as nonforest land.)

a. *Nonforest land without trees.*—Nonforest land with no live trees present.

b. *Nonforest land with trees.*—Nonforest land with one or more trees per acre at least 5 inches d.b.h.

Nonstocked land.—Forest land less than 16.7 percent stocked with all live trees.

Other forest land.—Forest land not capable of producing 20 cubic feet per acre per year of industrial wood crops under natural conditions and not associated with urban or rural development. These sites often contain tree species that are not currently utilized for industrial wood production or trees of poor form, small size, or inferior quality that are unfit for industrial products. Unproductivity may be the result of adverse site conditions such as sterile soil, dry climate, poor drainage, high elevation, and rockiness. This land is not withdrawn from timber utilization.

Other removals.—Growing-stock trees removed but not utilized for products, or trees left standing but "removed" from the timberland classification by land use change. Examples are removals from cultural operations such as timber stand improvement work, land clearing, and changes in land use.

Poletimber stand.—(See Stand-size class.)

Poletimber tree.—A growing-stock tree of commercial species at least 5.0 inches d.b.h. but smaller than sawtimber size.

Potential productivity class.—A classification of forest lands in terms of inherent capacity to grow crops of industrial wood. The class identifies the potential growth in merchantable cubic feet/acre/year at culmination of mean annual increment of fully stocked natural stands.

Reserved forest land.—Forest land withdrawn from timber utilization through statute, administrative regulation, designation, or exclusive use for Christmas tree production, as indicated by annual shearing.

Rotten tree.—A tree that does not meet regional merchantability standards because of excessive unsound cull. May include noncommercial tree species.

Rough tree.—A tree that does not meet regional merchantability standards because of excessive sound cull. May include noncommercial tree species.

Salvable dead tree.—A standing or down dead tree considered merchantable by regional standards.

Sapling.—A live tree 1.0 to 5.0 inches d.b.h.

Sapling-seedling stand.—(See Stand-size class.)

Saw log.—A log meeting minimum standards of diameter, length, and defect, including logs at least 8 feet long, sound and straight and with a minimum diameter outside bark (d.o.b.) for softwoods of 7.0 inches (9.0 inches for hardwoods) or other combinations of size and defect specified by regional standards.

Saw-log portion.—That part of the bole of sawtimber trees between the stump and the saw-log top.

Saw-log top.—The point on the bole of sawtimber trees above which a saw log cannot be produced. The minimum saw-log top is 7.0 inches d.o.b. for softwoods and 9.0 inches d.o.b. for hardwoods.

Sawtimber stand.—(See Stand-size class.)

Sawtimber tree.—A growing-stock tree of commercial species containing at least a 12-foot saw log or two noncontiguous saw logs 8 feet or longer, and meeting regional specifications for freedom from defect. Softwoods must be at least 9.0 inches d.b.h. Hardwoods must be at least 11.0 inches d.b.h.

Sawtimber volume.—Net volume of the saw-log portion of live sawtimber in board feet, International 1/4-inch rule (unless specified otherwise) from stump to a minimum 7 inches top diameter outside bark (d.o.b.) for softwoods and a minimum 9 inches top d.o.b. for hardwoods.

Seedling.—A live tree less than 1.0 inch d.b.h. that is expected to survive. Only softwood seedlings more than 6 inches tall and hardwood seedlings more than 1 foot tall are counted.

Short-log (rough tree).—Sawtimber-size trees of commercial species that contain at least one merchantable 8- to 11-foot saw log but not a 12-foot saw log.

Soft hardwoods.—Hardwood species with an average specific gravity less than 0.50 such as gum, yellow-poplar, cottonwood, red maple, basswood, and willow.

Softwoods.—Coniferous trees, usually evergreen, having needles or scale-like leaves.

Stand.—A group of trees on a minimum of 1 acre of forest land that is stocked by forest trees of any size.

Stand-size class.—A classification of stocked (see Stocking) forest land based on the size class of live trees on the area; that is, sawtimber, poletimber, or seedlings and saplings.

a. *Sawtimber stands.*—Stands with half or more of live stocking in sawtimber or poletimber trees, and with sawtimber stocking at least equal to poletimber stocking.

b. *Poletimber stands.*—Stands with half or more live stocking in poletimber and/or sawtimber trees, and with poletimber stocking exceeding that of sawtimber.

c. *Sapling-seedling stands.*—Stands with more than half of the live stocking in saplings and/or seedlings.

State land.—Land owned by States or leased to them for 50 years or more.

Stocking.—The degree of occupancy of land by live trees, measured by basal area and/or the number of trees in a stand by size or age and spacing, compared to the basal area and/or number of trees required to fully utilize the growth potential of the land; that is, the stocking standard.

A stocking percent of 100 indicates full utilization of the site and is equivalent to 80 square feet of basal area per acre in trees 5.0 inches d.b.h. and larger. In a stand of trees less than 5.0 inches d.b.h., a stocking percent of 100 would indicate that the present number of trees is sufficient to produce 80 square feet of basal area per acre when the trees reach 5.0 inches d.b.h.

Stands are grouped into the following stocking classes:

Overstocked stands.—Stands in which stocking of live trees is 133 percent or more.

Fully stocked stands.—Stands in which stocking of live trees is from 100.0 to 132.9 percent.

Medium stocked stands.—Stands in which stocking of live trees is from 60.0 to 99.9 percent.

Poorly stocked stands.—Stands in which stocking of live trees is from 16.7 to 59.9 percent.

Nonstocked areas.—Timberland on which stocking of live trees is less than 16.7 percent.

Timberland.—Forest land that is producing or capable of producing in excess of 20 cubic feet per acre per year of industrial wood crops under natural conditions, that is not withdrawn from timber utilization, and that is not associated with urban or rural development. Currently inaccessible and inoperable areas are included.

Tree.—A woody plant usually having one or more perennial stems, a more or less definitely formed crown of foliage, and a height of at least 12 feet at maturity.

Tree size class.—A classification of trees based on diameter at breast height, including sawtimber trees, poletimber trees, saplings, and seedlings.

Upper stem portion.—That part of the bole of sawtimber trees above the saw log top to a minimum top diameter of 4.0 inches outside bark or to the point where the central stem breaks into limbs.

TABLES

Table 1.—Area of land by county and major land-use class, Aspen-Birch Unit, Minnesota, 1990

Table 2.—Area of timberland by county and ownership class, Aspen-Birch Unit, Minnesota, 1990

Table 3.—Area of timberland by county and forest type, Aspen-Birch Unit, Minnesota, 1990

Table 4.—Area of timberland by county and stand-size class, Aspen-Birch Unit, Minnesota, 1990

Table 5.—Area of timberland by county and potential productivity class, Aspen-Birch Unit, Minnesota, 1990

Table 6.—Area of timberland by county and stocking class of growing-stock trees, Aspen-Birch Unit, Minnesota, 1990

Table 7.—Area of timberland by ownership class and stocking class of growing-stock trees, Aspen-Birch Unit, Minnesota, 1990

Table 8.—Area of timberland by forest type and ownership class, Aspen-Birch Unit, Minnesota, 1990

Table 9.—Area of timberland by forest type and stand-size class, Aspen-Birch Unit, Minnesota, 1990

Table 10.—Number of all live trees on timberland by species group and diameter class, Aspen-Birch Unit, Minnesota, 1990

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Table 12.—Net volume of timber on timberland by class of timber and species group, Aspen-Birch Unit, Minnesota, 1990

Table 13.—Net volume of growing-stock trees on timberland by species group and diameter class, Aspen-Birch Unit, Minnesota, 1990

Table 14.—Net volume of growing stock in the saw-log portion of sawtimber trees on timberland by species group and diameter class, Aspen-Birch Unit, Minnesota, 1990

Table 15.—Net volume of sawtimber trees on timberland by species group and diameter class, Aspen-Birch Unit, Minnesota, 1990

Table 16.—Net volume of growing-stock and sawtimber trees on timberland by county and species group, Aspen-Birch Unit, Minnesota, 1990

Table 17.—Net volume of live and growing-stock trees on timberland by ownership class and species group, Aspen-Birch Unit, Minnesota, 1990

Table 18.—Net volume of sawtimber trees on timberland by species group and butt log grade, Aspen-Birch Unit, Minnesota, 1990

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Table 21.—Average net annual growth, mortality, and removals of growing stock and sawtimber on timberland by species group, Aspen-Birch Unit, Minnesota, 1977-1989

Table 22.—Average net annual growth and average annual removals of growing stock on timberland by ownership class and species group, Aspen-Birch Unit, Minnesota, 1977-1989

Table 23.—Average net annual growth and average annual removals of sawtimber on timberland by ownership class and species group, Aspen-Birch Unit, Minnesota, 1977-1989

Table 24.—Current annual growth, mortality, and removals of growing stock and sawtimber on timberland by species group, Aspen-Birch Unit, Minnesota

Table 1.--Area of land by county and major land-use class, Aspen-Birch Unit, Minnesota, 1990

(In thousand acres)

		Forest land				
County	Land area	All forest land	Timberland	Timberland as a percent of land area	Other forest land	Reserved forest land
Carlton	552.8	352.6	340.5	61.6	5.2	6.9
Cook	903.8	854.9	565.4	62.6	2.9	286.6
Koochiching	1,989.1	1,732.8	1,423.9	71.6	287.7	21.2
Lake	1,313.7	1,199.1	850.1	64.7	19.2	329.8
St.Louis	3,919.9	3,222.6	2,698.8	68.8	165.0	358.8
All counties	8,679.3	7,362.0	5,878.7	67.7	480.0	1,003.3

Table 2.--Area of timberland by county and ownership class, Aspen-Birch Unit, Minnesota, 1990

(In thousand acres)

		Ownership class									
County	All owners	National forest	Bureau of Land Mgmt.	Misc. federal	State	County & municipal	Indian	Forest industry	Farmer	Misc. private corporation	Misc. private individual
Carlton	340.5	--	--	--	58.9	58.0	10.4	27.0	49.5	12.4	124.3
Cook	565.4	362.8	--	2.3	75.0	9.2	32.7	26.2	1.1	18.0	38.1
Koochiching	1,423.9	--	12.1	17.5	734.4	278.8	35.3	203.1	28.5	17.1	97.1
Lake	850.1	384.6	--	3.3	106.7	143.6	--	78.3	6.7	43.7	83.2
St. Louis	2,698.8	506.5	1.4	8.9	356.3	744.8	24.0	127.7	120.7	250.7	557.8
All counties	5,878.7	1,253.9	13.5	32.0	1,331.3	1,234.4	102.4	462.3	206.5	341.9	900.5

Table 3.--Area of timberland by county and forest type, Aspen-Birch Unit, Minnesota, 1990

(In thousand acres)

		Forest type														
County	All types	Jack pine	Red pine	White pine	Balsam fir	White spruce	Black spruce	Northern white-cedar	Tamarack	Oak-hickory	Elm-ash-soft maple	Maple-basswood	Aspen	Paper birch	Balsam poplar	Nonstocked
Carlton	340.5	--	5.9	0.6	14.3	2.3	22.1	4.8	25.1	3.2	43.0	29.5	145.1	21.7	15.1	7.8
Cook	565.4	9.1	7.8	3.6	92.9	16.1	62.6	52.5	3.5	--	14.1	42.3	182.6	71.5	4.2	2.6
Koochiching	1,423.9	17.4	19.0	1.7	90.5	8.2	332.6	226.0	98.8	1.3	129.3	19.9	374.3	24.8	67.6	12.5
Lake	850.1	25.6	29.4	8.7	124.6	18.5	133.1	51.3	3.8	1.5	33.4	60.8	189.9	153.2	12.6	3.7
St. Louis	2,698.8	85.9	58.9	18.7	223.5	21.1	392.8	109.4	124.1	3.3	168.0	112.0	1,100.3	185.9	57.1	37.8
All counties	5,878.7	138.0	121.0	33.3	545.8	66.2	943.2	444.0	255.3	9.3	387.8	264.5	1,992.2	457.1	156.6	64.4

Table 4.--Area of timberland by county and stand-size class, Aspen-Birch Unit, Minnesota, 1990

(In thousand acres)

County	All stands	Stand-size class			
		Sawtimber	Poletimber	Seedling & sapling	Nonstocked
Carlton	340.5	72.8	139.8	120.1	7.8
Cook	565.4	207.1	214.2	141.5	2.6
Koochiching	1,423.9	273.5	524.9	613.0	12.5
Lake	850.1	240.7	317.1	288.6	3.7
St. Louis	2,698.8	708.2	972.7	980.1	37.8
All counties	5,878.7	1,502.3	2,168.7	2,143.3	64.4

Table 5.--Area of timberland by county and potential productivity class, Aspen-Birch Unit, Minnesota, 1990

(In thousand acres)

County	All classes	Potential productivity class (cubic feet of growth per acre per year)				
		165+	120-164	85-119	50-84	20-49
Carlton	340.5	--	2.6	53.4	87.6	196.9
Cook	565.4	--	--	19.9	131.2	414.3
Koochiching	1,423.9	--	7.6	163.4	205.5	1,047.4
Lake	850.1	--	1.3	40.8	148.9	659.1
St. Louis	2,698.8	0.9	14.8	376.8	692.9	1,613.4
All counties	5,878.7	0.9	26.3	654.3	1,266.1	3,931.1

Table 6.--Area of timberland by county and stocking class of growing-stock trees[1], Aspen-Birch Unit, Minnesota, 1990

(In thousand acres)

County	All classes	Stocking percent of growing-stock trees: Non-stocked	Poorly stocked	Moderately stocked	Fully stocked	Over-stocked
Carlton	340.5	10.5	81.6	97.8	104.2	46.4
Cook	565.4	4.0	63.8	168.0	228.5	101.1
Koochiching	1,423.9	14.0	210.3	400.6	419.9	379.1
Lake	850.1	7.8	127.1	311.1	283.1	121.0
St. Louis	2,698.8	58.0	462.3	962.0	789.1	427.4
All counties	5,878.7	94.3	945.1	1,939.5	1,824.8	1,075.0

[1] This table is based on the stocking percent of growing-stock trees rather than that of all live trees, therefore, to use the definitions of stocking for this table, replace the term "all live" by "growing-stock".

Table 7.--Area of timberland by ownership class and stocking class of growing-stock trees[1], Aspen-Birch Unit, Minnesota, 1990

(In thousand acres)

		Stocking percent of growing-stock trees				
Ownership class	All classes	Non-stocked	Poorly stocked	Moderately stocked	Fully stocked	Over-stocked
National forest	1,253.9	13.8	93.6	384.9	515.2	246.4
Bureau of Land Mgmt.	13.5	--	1.4	1.1	6.0	5.0
Miscellaneous federal	32.0	--	5.4	9.8	8.7	8.1
State	1,331.3	18.9	184.5	398.4	415.2	314.3
County and municipal	1,234.4	26.4	252.1	430.2	321.7	204.0
Indian	102.4	--	18.6	30.4	29.1	24.3
Forest Industry	462.3	2.5	59.8	142.0	149.2	108.8
Farmer	206.5	8.0	27.3	79.3	67.3	24.6
Miscellaneous private corporation	341.9	4.4	47.5	146.5	94.0	49.5
Miscellaneous private individual	900.5	20.3	254.9	316.9	218.4	90.0
All owners	5,878.7	94.3	945.1	1,939.5	1,824.8	1,075.0

[1] This table is based on the stocking percent of growing-stock trees rather than that of all live trees, therefore, to use the definitions of stocking for this table, replace the term "all live" by "growing-stock".

Table 8.--Area of timberland by forest type and ownership class, Aspen-Birch Unit, Minnesota, 1990

(In thousand acres)

		Ownership class									
Forest type	All owners	National forest	Bureau of Land Mgmt.	Misc. federal	State	County & municipal	Indian	Forest industry	Farmer	Misc. private corporation	Misc. private individual
Jack pine	138.0	63.7	--	2.5	26.5	17.1	--	8.6	2.3	5.4	11.9
Red pine	121.0	60.6	--	2.7	17.0	14.2	1.7	8.8	0.7	3.4	11.9
White pine	33.3	11.3	--	--	3.0	3.3	0.7	6.0	--	2.8	6.2
Balsam fir	545.8	168.0	--	--	100.8	107.1	7.0	53.8	15.6	35.6	57.9
White spruce	66.2	24.8	--	--	11.4	10.5	1.7	4.2	1.5	1.8	10.3
Black spruce	943.2	211.3	9.2	5.3	378.1	147.2	8.4	53.9	21.5	34.1	74.2
Northern white-cedar	444.0	66.0	1.3	6.5	184.9	79.5	21.4	43.1	5.7	13.5	22.1
Tamarack	255.3	9.7	1.0	1.3	123.5	57.6	--	3.8	6.6	9.4	42.4
Oak-hickory	9.3	2.8	--	--	1.1	--	--	--	0.8	--	4.6
Elm-ash-soft maple	387.8	25.3	0.9	--	63.5	110.1	7.6	40.2	29.4	21.0	89.8
Maple-basswood	264.5	55.1	--	2.3	26.6	61.4	5.3	27.4	12.3	22.0	52.1
Aspen	1,992.2	408.4	1.1	5.9	292.3	464.6	34.8	172.1	84.4	143.1	385.5
Paper birch	457.1	132.8	--	4.4	65.7	96.1	13.8	24.0	10.0	37.0	73.3
Balsam poplar	156.6	5.3	--	1.1	23.2	46.6	--	15.0	12.5	9.8	43.1
Nonstocked	64.4	8.8	--	--	13.7	19.1	--	1.4	3.2	3.0	15.2
All types	5,878.7	1,253.9	13.5	32.0	1,331.3	1,234.4	102.4	462.3	206.5	341.9	900.5

Table 9.--Area of timberland by forest type and stand-size class, Aspen-Birch Unit, Minnesota, 1990

(In thousand acres)

Forest type	All stands	Stand-size class: Sawtimber	Poletimber	Seedling & sapling	Nonstocked
Jack pine	138.0	73.6	30.0	34.4	--
Red pine	121.0	74.1	23.5	23.4	--
White pine	33.3	28.8	2.6	1.9	--
Balsam fir	545.8	123.9	237.0	184.9	--
White spruce	66.2	24.2	23.8	18.2	--
Black spruce	943.2	47.6	331.7	563.9	--
Northern white-cedar	444.0	208.2	157.6	78.2	--
Tamarack	255.3	42.1	69.5	143.7	--
Oak-hickory	9.3	2.9	1.7	4.7	--
Elm-ash-soft maple	387.8	74.5	178.1	135.2	--
Maple-basswood	264.5	117.8	84.3	62.4	--
Aspen	1,992.2	534.9	702.3	755.0	--
Paper birch	457.1	97.4	276.5	83.2	--
Balsam poplar	156.6	52.3	50.1	54.2	--
Nonstocked	64.4	--	--	--	64.4
All types	5,878.7	1,502.3	2,168.7	2,143.3	64.4

Table 10.--Number of all live trees on timberland by species group and diameter class, Aspen-Birch Unit, Minnesota, 1990

(In thousand trees)

Species group	All classes	Diameter class (inches at breast height)											
		1.0-2.9	3.0-4.9	5.0-6.9	7.0-8.9	9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-28.9	29.0+
Softwoods													
Jack pine	52,603	18,792	10,457	8,926	6,186	4,366	2,345	1,099	291	101	32	8	--
Red pine	29,569	6,295	6,668	5,544	3,798	2,880	1,920	1,134	611	412	171	136	--
White pine	9,223	1,554	1,427	1,452	1,124	930	680	641	412	300	296	332	75
White spruce	53,217	20,336	11,605	8,800	5,166	2,949	2,032	1,103	592	369	159	106	--
Black spruce	738,443	358,626	235,255	104,953	31,029	7,034	1,216	201	95	22	5	6	1
Balsam fir	661,520	359,142	166,585	82,696	34,245	13,074	4,446	1,000	261	52	16	3	--
Tamarack	172,882	86,978	48,920	22,742	9,005	3,476	1,169	405	134	23	21	9	--
Eastern redcedar	200	--	90	90	20	--	--	--	--	--	--	--	--
Northern white-cedar	248,283	90,787	57,298	44,321	26,993	15,581	7,276	3,508	1,491	559	282	186	1
Other softwoods	4	--	--	--	--	--	--	4	--	--	--	--	--
Total	1,965,944	942,510	538,305	279,524	117,566	50,290	21,084	9,095	3,887	1,838	982	786	77
Hardwoods													
White oak	2,971	1,218	571	441	330	179	85	57	33	19	18	13	7
Select red oak	4,688	2,445	939	406	239	276	93	144	90	40	7	9	--
Other red oak	564	483	57	--	14	--	10	--	--	--	--	--	--
Hickory	--	--	--	--	--	--	--	--	--	--	--	--	--
Basswood	12,396	4,386	2,744	1,763	1,118	997	748	310	140	105	40	44	1
Yellow birch	4,183	1,506	567	584	455	273	191	237	121	91	66	82	10
Hard maple	88,203	41,977	19,931	14,634	6,455	2,650	1,155	614	349	206	106	124	2
Soft maple	119,582	58,376	31,303	18,734	6,908	2,718	846	388	180	67	35	27	--
Elm	9,529	5,345	2,072	951	481	162	114	126	106	69	45	55	3
Black ash	210,867	113,790	48,141	25,938	13,304	5,784	2,522	947	279	108	35	19	--
White and green ash	6,933	3,936	1,476	638	380	185	194	88	23	8	4	1	--
Cottonwood	83	--	--	34	--	27	14	6	--	--	2	--	--
Willow	136	48	--	49	20	8	6	5	--	--	--	--	--
Balsam poplar	109,213	59,471	18,244	12,099	8,314	5,556	3,206	1,335	600	232	101	55	--
Bigtooth aspen	13,738	7,266	1,458	1,414	1,477	1,067	607	293	103	46	6	1	--
Quaking aspen	760,910	455,166	120,098	62,112	48,701	36,048	21,177	10,423	4,585	1,621	570	403	6
Paper birch	314,605	114,083	77,817	59,272	35,409	17,736	6,449	2,311	937	377	125	86	3
Black cherry	2,135	1,592	462	45	22	10	--	4	--	--	--	--	--
Black walnut	--	--	--	--	--	--	--	--	--	--	--	--	--
Other hardwoods	3,175	2,221	501	156	169	87	18	2	21	--	--	--	--
Noncommercial sp.	97,401	93,356	3,143	616	257	11	8	10	--	--	--	--	--
Total	1,761,312	966,665	329,524	199,886	124,053	73,774	37,443	17,300	7,567	2,989	1,160	919	32
All species	3,727,256	1,909,175	867,829	479,410	241,619	124,064	58,527	26,395	11,454	4,827	2,142	1,705	109

Table 11.--Number of growing-stock trees on timberland by species group and diameter class, Aspen-Birch Unit, Minnesota, 1990

(In thousand trees)

		Diameter class (inches at breast height)											
Species group	All classes	1.0-2.9	3.0-4.9	5.0-6.9	7.0-8.9	9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-28.9	29.0+
Softwoods													
Jack pine	51,539	18,759	10,104	8,769	5,991	4,227	2,238	1,056	273	86	28	8	--
Red pine	28,963	6,129	6,408	5,512	3,765	2,819	1,884	1,121	608	412	169	136	--
White pine	8,520	1,554	1,427	1,152	1,001	824	616	579	389	298	283	323	74
White spruce	52,346	20,237	11,392	8,425	5,111	2,844	2,020	1,098	585	369	159	106	--
Black spruce	730,607	355,894	231,775	104,005	30,534	6,911	1,170	201	83	22	5	6	1
Balsam fir	644,985	353,214	159,263	80,701	33,576	12,747	4,235	935	245	50	16	3	--
Tamarack	169,204	86,541	47,229	22,116	8,586	3,183	1,047	348	112	15	21	6	--
Eastern redcedar	200	--	90	90	20	--	--	--	--	--	--	--	--
Northern white-cedar	217,796	86,581	49,904	36,686	22,110	12,437	5,560	2,639	1,131	425	194	128	1
Other softwoods	4	--	--	--	--	--	--	4	--	--	--	--	--
Total	1,904,164	928,909	517,592	267,456	110,694	45,992	18,770	7,981	3,426	1,677	875	716	76
Hardwoods													
White oak	2,777	1,218	544	343	312	154	75	57	23	13	18	13	7
Select red oak	4,403	2,445	825	365	193	232	89	126	79	36	7	6	--
Other red oak	550	483	57	--	--	--	10	--	--	--	--	--	--
Hickory	--	--	--	--	--	--	--	--	--	--	--	--	--
Basswood	11,837	4,353	2,531	1,683	1,096	921	696	262	130	95	38	32	--
Yellow birch	3,234	1,506	432	511	255	147	88	126	68	36	30	34	1
Hard maple	77,906	39,312	17,615	12,481	5,218	1,877	691	374	140	106	46	46	--
Soft maple	107,999	57,194	27,656	15,124	5,433	1,832	425	190	91	23	22	9	--
Elm	8,916	5,235	1,860	916	379	126	97	92	80	59	26	44	2
Black ash	201,626	111,027	44,588	24,521	12,605	5,348	2,268	887	245	90	32	15	--
White and green ash	6,580	3,936	1,344	563	362	152	130	64	23	5	--	1	--
Cottonwood	83	--	--	34	--	27	14	6	--	--	2	--	--
Willow	59	48	--	--	--	--	6	5	--	--	--	--	--
Balsam poplar	105,645	59,301	17,100	11,320	7,603	5,267	2,984	1,229	537	192	70	42	--
Bigtooth aspen	13,321	7,266	1,377	1,312	1,436	1,030	534	233	90	39	4	--	--
Quaking aspen	738,663	453,578	116,132	58,178	45,114	32,913	18,592	8,706	3,669	1,159	403	217	2
Paper birch	297,785	111,218	72,975	55,917	32,751	16,240	5,681	1,949	705	245	61	41	2
Black cherry	1,952	1,413	462	45	22	10	--	--	--	--	--	--	--
Black walnut	--	--	--	--	--	--	--	--	--	--	--	--	--
Other hardwoods	2,833	2,221	399	90	102	19	2	--	--	--	--	--	--
Total	1,586,169	861,754	305,897	183,403	112,881	66,295	32,382	14,306	5,880	2,098	759	500	14
All species	3,490,333	1,790,663	823,489	450,859	223,575	112,287	51,152	22,287	9,306	3,775	1,634	1,216	90

Table 12.--Net volume of timber on timberland by class of timber and species group, Aspen-Birch Unit, Minnesota, 1990

(In thousand cubic feet)

Class of timber	All species	Species group			
		Pine	Other softwoods	Soft hardwoods	Hard hardwoods
Live trees					
Growing-stock trees					
Sawtimber					
Saw-log portion	1,955,134	335,732	732,179	789,779	97,444
Upper stem portion	499,867	43,926	109,375	310,298	36,268
Total	2,455,001	379,658	841,554	1,100,077	133,712
Poletimber	3,153,270	95,791	1,202,017	1,568,619	286,843
All growing-stock trees	5,608,271	475,449	2,043,571	2,668,696	420,555
Cull trees					
Short-log trees	48,941	3,397	14,437	24,982	6,125
Rough trees					
Sawtimber	98,272	5,089	26,872	52,859	13,452
Poletimber	128,559	2,038	29,549	70,180	26,792
Total	226,831	7,127	56,421	123,039	40,244
Rotten trees					
Sawtimber	99,974	1,218	24,919	59,739	14,098
Poletimber	40,385	226	11,036	25,086	4,037
Total	140,359	1,444	35,955	84,825	18,135
All cull trees	416,131	11,968	106,813	232,846	64,504
All live trees	6,024,402	487,417	2,150,384	2,901,542	485,059
Salvable dead trees					
Sawtimber	31,075	1,797	10,232	18,592	454
Poltetimber	29,500	536	13,144	15,640	180
Total	60,575	2,333	23,376	34,232	634
All classes of timber	6,084,977	489,750	2,173,760	2,935,774	485,693

Table 13.--Net volume of growing-stock trees on timberland by species group and diameter class, Aspen-Birch Unit, Minnesota, 1990

(In thousand cubic feet)

		Diameter class (inches at breast height)									
Species group	All classes	5.0-6.9	7.0-8.9	9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-28.9	29.0+
Softwoods											
Jack pine	166,927	20,502	31,431	41,135	34,700	24,323	9,066	3,675	1,439	656	--
Red pine	180,592	14,674	21,225	28,444	30,968	26,810	20,049	18,041	9,860	10,521	--
White pine	127,846	2,614	5,345	7,907	9,757	13,686	13,025	13,602	16,609	32,061	13,240
White spruce	203,918	21,997	30,826	31,520	35,498	28,335	20,851	17,058	9,385	8,448	--
Black spruce	560,642	278,852	179,426	73,103	19,512	4,983	3,003	987	255	429	92
Balsam fir	620,953	200,996	189,319	129,147	68,065	22,163	8,053	2,156	841	213	--
Tamarack	177,955	60,233	52,073	34,238	17,538	8,070	3,679	618	1,077	429	--
Eastern redcedar	275	187	88	--	--	--	--	--	--	--	--
Northern white-cedar	479,828	80,732	107,288	106,979	73,272	51,045	29,090	14,894	8,469	7,989	70
Other softwoods	84	--	--	--	--	84	--	--	--	--	--
Total	2,519,020	680,787	617,021	452,473	289,310	179,499	106,816	71,031	47,935	60,746	13,402
Hardwoods											
White oak	9,785	871	1,520	1,365	1,061	1,118	607	485	919	797	1,042
Select red oak	12,373	754	988	2,230	1,293	2,636	2,397	1,366	351	358	--
Other red oak	128	--	--	--	128	--	--	--	--	--	--
Hickory	--	--	--	--	--	--	--	--	--	--	--
Basswood	49,600	4,538	6,539	9,504	10,912	6,035	3,950	3,983	1,845	2,294	--
Yellow birch	14,240	1,171	1,384	1,479	1,340	2,550	1,737	1,326	1,251	1,927	75
Hard maple	116,152	33,030	30,169	19,019	11,143	8,691	4,319	4,416	2,276	3,089	--
Soft maple	102,150	37,016	30,547	18,186	6,822	4,223	2,782	857	1,060	657	--
Elm	18,768	1,972	2,149	1,399	1,427	2,047	2,515	2,368	1,361	3,216	314
Black ash	258,115	62,114	71,663	53,669	35,919	20,720	7,910	3,561	1,610	949	--
White and green ash	8,901	1,267	1,889	1,432	1,894	1,391	695	258	--	75	--
Cottonwood	765	97	--	220	206	151	--	--	91	--	--
Willow	174	--	--	--	84	90	--	--	--	--	--
Balsam poplar	243,221	30,082	45,459	55,576	48,851	30,107	17,734	8,322	3,864	3,226	--
Bigtooth aspen	43,341	3,846	8,869	11,072	8,920	5,550	3,064	1,797	223	--	--
Quaking aspen	1,503,590	153,268	269,178	350,931	308,569	210,346	122,111	49,979	22,211	16,692	305
Paper birch	706,773	155,236	200,236	172,385	93,704	45,990	22,622	10,076	3,167	2,977	380
Black cherry	314	117	111	86	--	--	--	--	--	--	--
Black walnut	--	--	--	--	--	--	--	--	--	--	--
Other hardwoods	861	226	447	156	32	--	--	--	--	--	--
Total	3,089,251	485,605	671,148	698,709	532,305	341,645	192,443	88,794	40,229	36,257	2,116
All species	5,608,271	1,166,392	1,288,169	1,151,182	821,615	521,144	299,259	159,825	88,164	97,003	15,518

Table 14.--Net volume of growing stock in the saw-log portion of sawtimber trees on timberland by species group and diameter class, Aspen-Birch Unit, Minnesota, 1990

(In thousand cubic feet)

Species group	All classes	Diameter class (inches at breast height) 9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-28.9	29.0+
Softwoods									
Jack pine	98,867	33,612	30,274	21,637	8,134	3,315	1,301	594	--
Red pine	132,854	25,008	28,595	24,969	18,665	16,767	9,130	9,720	--
White pine	103,936	6,164	8,220	11,789	11,337	11,894	14,568	28,212	11,752
White spruce	136,854	27,128	32,203	26,049	19,239	15,758	8,667	7,810	--
Black spruce	94,176	66,416	18,499	4,747	2,847	934	242	404	87
Balsam fir	193,319	104,445	59,124	19,672	7,198	1,934	755	191	--
Tamarack	57,720	29,181	15,815	7,391	3,377	567	994	395	--
Eastern redcedar	--	--	--	--	--	--	--	--	--
Northern white-cedar	250,110	86,897	63,547	45,304	26,059	13,385	7,634	7,220	64
Other softwoods	75	--	--	75	--	--	--	--	--
Total	1,067,911	378,851	256,277	161,633	96,856	64,554	43,291	54,546	11,903
Hardwoods									
White oak	4,447	--	689	798	450	365	703	619	823
Select red oak	6,108	--	826	1,887	1,802	1,047	269	277	--
Other red oak	80	--	80	--	--	--	--	--	--
Hickory	--	--	--	--	--	--	--	--	--
Basswood	21,183	--	7,315	4,465	3,038	3,100	1,450	1,815	--
Yellow birch	7,931	--	922	1,914	1,366	1,068	1,016	1,583	62
Hard maple	24,489	--	7,257	6,322	3,276	3,414	1,781	2,439	--
Soft maple	11,370	--	4,316	3,003	2,067	653	817	514	--
Elm	9,510	--	862	1,410	1,805	1,738	1,015	2,438	242
Black ash	51,296	--	24,609	15,646	6,171	2,827	1,280	763	--
White and green ash	3,071	--	1,259	1,021	533	199	--	59	--
Cottonwood	287	--	117	102	--	--	68	--	--
Willow	109	--	48	61	--	--	--	--	--
Balsam poplar	80,103	--	32,675	22,082	13,450	6,399	2,982	2,515	--
Bigtooth aspen	14,249	--	6,121	4,169	2,377	1,407	175	--	--
Quaking aspen	530,416	--	210,454	156,543	93,718	38,897	17,399	13,164	241
Paper birch	122,552	--	60,437	32,746	16,780	7,596	2,412	2,286	295
Black cherry	--	--	--	--	--	--	--	--	--
Black walnut	--	--	--	--	--	--	--	--	--
Other hardwoods	22	--	22	--	--	--	--	--	--
Total	887,223	--	358,009	252,169	146,833	68,710	31,367	28,472	1,663
All species	1,955,134	378,851	614,286	413,802	243,689	133,264	74,658	83,018	13,566

Table 15.--Net volume of sawtimber trees on timberland by species group and diameter class, Aspen-Birch Unit, Minnesota, 1990

(In thousand board feet)[1]

Species group	All classes	Diameter class (inches at breast height) 9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-28.9	29.0+
Softwoods									
Jack pine	572,196	196,174	170,901	124,487	48,390	20,259	8,136	3,849	--
Red pine	772,625	143,324	159,231	142,077	109,261	100,806	56,268	61,658	--
White pine	643,007	36,530	46,364	67,454	66,766	72,188	90,484	183,165	80,056
White spruce	817,367	160,585	185,727	152,842	115,883	97,216	54,575	50,539	--
Black spruce	541,657	381,646	104,849	27,583	17,105	5,750	1,520	2,622	582
Balsam fir	1,128,021	617,682	336,133	113,755	42,751	11,807	4,681	1,212	--
Tamarack	339,929	172,758	91,226	43,353	20,324	3,489	6,236	2,543	--
Eastern redcedar	--	--	--	--	--	--	--	--	--
Northern white-cedar	1,508,414	539,138	372,509	265,727	155,556	81,547	47,382	46,133	422
Other softwoods	428	--	--	428	--	--	--	--	--
Total	6,323,644	2,247,837	1,466,940	937,706	576,036	393,062	269,282	351,721	81,060
Hardwoods									
White oak	28,250	--	4,351	4,883	2,768	2,276	4,430	3,973	5,569
Select red oak	37,827	--	5,250	11,540	11,062	6,495	1,702	1,778	--
Other red oak	521	--	521	--	--	--	--	--	--
Hickory	--	--	--	--	--	--	--	--	--
Basswood	133,046	--	46,486	27,496	18,790	19,364	9,161	11,749	--
Yellow birch	50,340	--	5,963	12,005	8,522	6,718	6,460	10,259	413
Hard maple	155,292	--	46,824	39,392	20,416	21,486	11,333	15,841	--
Soft maple	72,308	--	27,947	18,776	12,906	4,109	5,222	3,348	--
Elm	60,348	--	5,616	8,755	11,203	10,888	6,442	15,813	1,631
Black ash	322,175	--	156,671	96,559	38,233	17,663	8,131	4,918	--
White and green ash	18,986	--	7,880	6,207	3,267	1,251	--	381	--
Cottonwood	1,807	--	756	623	--	--	428	--	--
Willow	686	--	314	372	--	--	--	--	--
Balsam poplar	499,327	--	205,368	135,440	83,114	40,089	18,992	16,324	--
Bigtooth aspen	88,566	--	38,366	25,574	14,698	8,818	1,110	--	--
Quaking aspen	3,299,625	--	1,318,904	959,990	578,847	243,751	110,799	85,704	1,630
Paper birch	773,942	--	386,083	203,292	104,484	47,798	15,388	14,904	1,993
Black cherry	--	--	--	--	--	--	--	--	--
Black walnut	--	--	--	--	--	--	--	--	--
Other hardwoods	136	--	136	--	--	--	--	--	--
Total	5,543,182	--	2,257,436	1,550,904	908,310	430,706	199,598	184,992	11,236
All species	11,866,826	2,247,837	3,724,376	2,488,610	1,484,346	823,768	468,880	536,713	92,296

[1] International 1/4-inch rule.

Table 16.--Net volume of growing-stock and sawtimber trees on timberland by county and species group, Aspen-Birch Unit, Minnesota, 1990

County	Growing stock					Sawtimber				
		Species group					Species group			
	All species	Pine	Other softwoods	Soft hardwoods	Hard hardwoods	All species	Pine	Other softwoods	Soft hardwoods	Hard hardwoods
	Thousand cubic feet					Thousand board feet[1]				
Carlton	314,513	19,311	62,781	170,599	61,822	585,823	93,154	140,485	274,701	77,483
Cook	696,162	43,688	297,694	308,262	46,518	1,662,772	180,472	801,283	583,793	97,224
Koochiching	1,253,029	47,919	614,759	493,471	96,880	2,332,450	167,629	1,124,489	895,863	144,469
Lake	840,147	97,924	295,802	376,618	69,803	1,854,404	360,476	739,827	635,925	118,176
St. Louis	2,504,420	266,607	772,535	1,319,746	145,532	5,431,377	1,186,525	1,529,304	2,539,373	176,175
All counties	5,608,271	475,449	2,043,571	2,668,696	420,555	11,866,826	1,988,256	4,335,388	4,929,655	613,527

[1] International 1/4-inch rule.

Table 17.--Net volume of live and growing-stock trees on timberland by ownership class and species group, Aspen-Birch Unit, Minnesota, 1990

(In thousand cubic feet)

Ownership class	Live trees					Growing stock				
		Species group					Species group			
	All species	Pine	Other softwoods	Soft hardwoods	Hard hardwoods	All species	Pine	Other softwoods	Soft hardwoods	Hard hardwoods
National forest	1,418,666	220,927	482,952	654,463	60,324	1,358,019	218,750	469,557	618,270	51,442
Bureau of Land Mgmt.	6,428	--	3,861	1,846	721	6,193	--	3,839	1,633	721
Miscellaneous federal	42,996	9,304	13,392	17,534	2,766	40,438	9,304	12,841	15,731	2,562
State	1,198,601	70,517	638,649	421,698	67,737	1,114,511	67,856	602,899	383,659	60,097
County and municipal	1,331,171	64,166	401,462	719,585	145,958	1,223,668	61,621	375,250	659,120	127,677
Indian	126,242	3,980	57,333	56,902	8,027	114,829	3,818	53,037	51,281	6,693
Forest industry	449,459	25,547	181,127	206,772	36,013	414,937	24,354	169,745	189,422	31,416
Farmer	182,819	6,133	45,397	107,127	24,162	169,520	6,025	43,040	98,649	21,806
Miscellaneous private corporation	336,693	20,909	103,595	183,376	28,813	309,232	20,052	100,044	168,580	20,556
Miscellaneous private individual	931,327	65,934	222,616	532,239	110,538	856,924	63,669	213,319	482,351	97,585
All owners	6,024,402	487,417	2,150,384	2,901,542	485,059	5,608,271	475,449	2,043,571	2,668,696	420,555

Table 18.--Net volume of sawtimber trees on timberland by species group and butt log grade, Aspen-Birch Unit, Minnesota, 1990

(In thousand board feet)[1]

Species group	All grades	Butt log grade 1	2	3	Tie and timber
Softwoods					
Jack pine	572,196	7,812	39,662	524,722	--
Red pine	772,625	71,061	111,229	590,335	--
White pine	643,007	139,420	180,402	306,798	16,387
White spruce	817,367	13,289	49,227	754,851	--
Black spruce	541,657	--	7,844	533,813	--
Balsam fir	1,128,021	--	7,333	1,120,688	--
Tamarack	339,929	--	19,637	320,292	--
Eastern redcedar	--	--	--	--	--
Northern white-cedar	1,508,414	13,442	133,271	1,361,701	--
Other softwoods	428	--	39	389	--
Total	6,323,644	245,024	548,644	5,513,589	16,387
Hardwoods					
White oak	28,250	--	--	19,050	9,200
Select red oak	37,827	3,137	10,965	22,260	1,465
Other red oak	521	--	--	521	--
Hickory	--	--	--	--	--
Basswood	133,046	24,105	25,192	79,388	4,361
Yellow birch	50,340	14,940	9,205	20,611	5,584
Hard maple	155,292	13,229	26,309	103,457	12,297
Soft maple	72,308	1,793	4,762	49,076	16,677
Elm	60,348	12,421	18,286	23,346	6,295
Black ash	322,175	12,888	60,367	228,722	20,198
White and green ash	18,986	1,568	4,579	11,023	1,816
Cottonwood	1,807	--	--	1,807	--
Willow	686	--	--	686	--
Balsam poplar	499,327	31,540	66,790	358,254	42,743
Bigtooth aspen	88,566	2,007	29,744	54,514	2,301
Quaking aspen	3,299,625	151,782	471,921	2,454,944	220,978
Paper birch	773,942	28,250	129,427	560,962	55,303
Black cherry	--	--	--	--	--
Black walnut	--	--	--	--	--
Other hardwoods	136	--	--	136	--
Total	5,543,182	297,660	857,547	3,988,757	399,218
All species	11,866,826	542,684	1,406,191	9,502,346	415,605

[1] International 1/4-inch rule.

Table 19.--Average net annual growth of growing stock and sawtimber on timberland by county and species group, Aspen-Birch Unit, Minnesota, 1977-1989

County	Growing stock					Sawtimber				
		Species group					Species group			
	All species	Pine	Other softwoods	Soft hardwoods	Hard hardwoods	All species	Pine	Other softwoods	Soft hardwoods	Hard hardwoods
	Thousand cubic feet					Thousand board feet[1]				
Carlton	9,247	572	1,753	5,138	1,784	24,167	3,291	5,608	12,122	3,146
Cook	11,932	1,404	3,712	5,625	1,191	44,116	5,976	18,258	18,099	1,783
Koochiching	32,108	1,729	13,555	14,344	2,480	88,253	6,846	36,679	39,286	5,442
Lake	18,436	2,847	5,686	7,945	1,958	65,261	10,512	25,141	25,838	3,770
St. Louis	60,398	6,371	18,126	31,436	4,465	218,470	33,241	63,816	113,640	7,773
All counties	132,121	12,923	42,832	64,488	11,878	440,267	59,866	149,502	208,985	21,914

[1] International 1/4-inch rule.

Table 20.--Average annual removals of growing stock and sawtimber on timberland by county and species group, Aspen-Birch Unit, Minnesota, 1977-1989

County	Growing stock					Sawtimber				
		Species group					Species group			
	All species	Pine	Other softwoods	Soft hardwoods	Hard hardwoods	All species	Pine	Other softwoods	Soft hardwoods	Hard hardwoods
	Thousand cubic feet					Thousand board feet[1]				
Carlton	3,657	185	531	2,358	583	5,976	870	1,196	3,351	559
Cook	10,016	2,217	3,594	4,138	67	26,188	9,564	5,996	10,628	--
Koochiching	24,671	2,100	8,308	13,590	673	52,989	6,569	18,578	26,542	1,300
Lake	10,952	370	3,467	6,826	289	20,248	1,806	5,749	12,376	317
St. Louis	33,410	4,046	6,834	21,242	1,288	71,982	18,810	13,090	38,618	1,464
All counties	82,706	8,918	22,734	48,154	2,900	177,383	37,619	44,609	91,515	3,640

[1] International 1/4-inch rule.

Table 21.--Average net annual growth, mortality, and removals of growing stock and sawtimber on timberland by species group, Aspen-Birch Unit, Minnesota, 1977-1989

	Growing stock			Sawtimber		
Species group	Net growth[1]	Mortality	Removals	Net growth[1]	Mortality	Removals
	Thousand cubic feet			*Thousand board feet*[2]		
Softwoods						
Jack pine	2,109	3,600	3,222	8,083	13,984	10,384
Red pine	6,772	54	2,876	28,893	177	13,045
White pine	4,041	406	2,820	22,883	2,219	14,190
White spruce	9,228	1,246	3,321	38,178	5,044	15,515
Black spruce	8,777	10,156	9,434	19,931	11,551	11,153
Balsam fir	10,079	21,627	7,681	39,719	37,290	11,295
Tamarack	5,239	1,251	576	13,986	2,373	1,305
Eastern redcedar	15	--	--	--	--	--
Northern white-cedar	9,494	1,258	1,722	37,688	5,182	5,341
Other softwoods	1	--	--	7	--	--
Total	55,755	39,598	31,652	209,368	77,820	82,228
Hardwoods						
White oak	281	2	65	833	--	247
Select red oak	384	43	53	1,101	85	88
Other red oak	6	--	--	--	2	--
Hickory	--	--	--	--	--	--
Basswood	1,272	258	461	5,277	476	875
Yellow birch	124	172	--	773	655	--
Hard maple	4,364	238	692	5,077	617	315
Soft maple	4,784	859	503	4,113	264	285
Elm	-1,837	2,747	698	-5,184	8,137	2,499
Black ash	6,367	1,472	1,970	13,095	2,001	2,949
White and green ash	323	29	120	998	9	41
Cottonwood	22	1	--	79	--	--
Willow	14	--	--	57	--	--
Balsam poplar	3,316	5,749	3,851	13,175	11,333	7,270
Bigtooth aspen	1,279	430	1,203	4,835	568	1,891
Quaking aspen	44,585	22,340	30,509	160,053	42,710	67,750
Paper birch	11,019	8,817	10,929	26,580	9,257	10,945
Black cherry	34	1	--	--	--	--
Black walnut	--	--	--	--	--	--
Other hardwoods	29	36	--	10	--	--
Total	76,366	43,194	51,054	230,899	76,114	95,155
All species	132,121	82,792	82,807	440,267	153,934	177,383

[1] An estimate of average gross growth may be computed by adding average mortality to average net growth.

[2] International 1/4-inch rule.

Table 22.--Average net annual growth and average annual removals of growing stock on timberland by ownership class and species group, Aspen-Birch, Minnesota, 1977-1989

(In thousand cubic feet)

	Growth					Removals				
		Species group					Species group			
Ownership class	All species	Pine	Other softwoods	Soft hardwoods	Hard hardwoods	All species	Pine	Other softwoods	Soft hardwoods	Hard hardwoods
National forest	30,901	6,384	9,358	13,793	1,366	21,065	3,707	5,338	12,020	--
Bureau of Land Mgmt.	147	--	131	-9	25	--	--	--	--	--
Miscellaneous federal	1,075	271	313	371	120	496	203	241	52	--
State	24,423	1,309	12,132	9,376	1,606	17,846	1,886	6,961	8,583	416
County and municipal	28,934	1,766	7,536	15,660	3,972	15,897	857	2,603	11,591	846
Indian	1,918	139	500	1,190	89	825	--	107	619	99
Forest industry	10,613	640	3,470	5,728	775	11,915	1,040	3,695	6,746	434
Farmer	4,317	121	1,344	2,192	660	2,364	29	136	1,829	370
Miscellaneous private corporation	7,973	552	2,481	4,227	713	5,178	406	2,156	2,474	142
Miscellaneous private individual	21,820	1,741	5,567	11,960	2,552	7,120	790	1,497	4,240	593
All owners	132,121	12,923	42,832	64,488	11,878	82,706	8,918	22,734	48,154	2,900

Table 23.--Average net annual growth and average annual removals of sawtimber on timberland by ownership class and species group, Aspen-Birch Unit, Minnesota, 1977-1989

(In thousand board feet)[1]

	Growth					Removals				
		Species group					Species group			
Ownership class	All species	Pine	Other softwoods	Soft hardwoods	Hard hardwoods	All species	Pine	Other softwoods	Soft hardwoods	Hard hardwoods
National forest	123,369	28,724	40,397	51,523	2,725	47,616	16,814	8,058	22,744	--
Bureau of Land Mgmt.	372	--	289	43	40	--	--	--	--	--
Miscellaneous federal	3,117	1,237	452	1,376	52	1,256	981	230	45	--
State	71,473	6,412	35,188	27,353	2,520	41,308	7,647	16,030	16,662	969
County and municipal	94,210	7,534	26,115	53,510	7,051	32,918	3,179	5,578	23,120	1,041
Indian	5,839	538	1,617	3,471	213	1,411	--	310	842	259
Forest industry	31,157	3,497	11,736	14,602	1,322	23,679	3,522	7,409	12,368	380
Farmer	12,642	673	4,270	6,663	1,036	3,247	106	--	2,972	169
Miscellaneous private corporation	25,673	2,580	8,817	12,971	1,305	9,632	1,943	3,245	4,404	40
Miscellaneous private individual	72,415	8,671	20,621	37,473	5,650	16,316	3,427	3,749	8,358	782
All owners	440,267	59,866	149,502	208,985	21,914	177,383	37,619	44,609	91,515	3,640

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[1] International 1/4-inch rule.

Table 24.--Current annual growth, mortality, and removals of growing stock and sawtimber on timberland by species group, Aspen-Birch Unit, Minnesota

Species group	Growing stock 1989 Net growth[1]	Growing stock 1989 Mortality	Growing stock 1988 Removals[2]	Sawtimber 1989 Net growth[1]	Sawtimber 1989 Mortality	Sawtimber 1988 Removals[2]
	Thousand cubic feet			*Thousand board feet*[3]		
Softwoods						
Jack pine	1,664	4,057	6,236	3,688	16,519	21,784
Red pine	6,883	13	4,282	27,232	95	19,892
White pine	4,499	94	2,192	25,333	1,243	11,878
Spruce	19,333	12,220	10,986	69,662	16,680	28,160
Balsam fir	13,365	19,185	8,989	52,117	33,328	20,321
Tamarack	5,128	1,750	766	16,155	2,932	1,690
Cedar	11,320	763	801	42,775	5,271	2,792
Other softwoods	14	--	--	17	--	--
Total	62,206	38,082	34,252	236,979	75,986	106,517
Hardwoods						
White oak	306	0	127	1,406	1	312
Red oak	410	63	242	1,862	137	627
Basswood	1,472	303	85	5,043	645	242
Yellow birch	94	219	--	665	770	3
Hard maple	5,090	202	321	6,595	640	568
Soft maple	5,075	1,409	517	6,226	592	784
Elm	-17	535	178	605	1,690	314
Ash	7,929	1,950	1,175	14,661	3,078	1,844
Cottonwood	12	7	--	32	15	--
Balsam poplar	4,326	6,073	2,690	19,918	12,076	7,282
Aspen	49,332	25,908	55,134	187,820	57,844	153,161
Paper birch	12,936	9,068	7,631	35,236	9,996	19,520
Other hardwoods	152	27	--	164	12	--
Total	87,117	45,764	68,100	280,233	87,496	184,657
All species	149,323	83,846	102,352	517,212	163,482	291,174

[1] An estimate of current gross growth may be computed by adding current mortality to current net growth.

[2] Based on data from a 1988 mill survey and a1989-1990 logging utilization study, and on land use change estimates from the new inventory.

[3] International 1/4-inch rule.

Kingsley, Neal P.
1991. **Forest statistics for Minnesota's Aspen-Birch Unit**. Resour. Bull. NC-128. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station. 42 p.

The fifth inventory of Minnesota's Aspen-Birch Unit reports 8.7 million acres of land, of which 7.4 million acres are forested. This bulletin presents statistical highlights and contains detailed tables of forest area, as well as timber volume, growth, removals, mortality, and ownership.

KEY WORDS: Forest area, timber volume, growth, removals, mortality.

Our job at the North Central Forest Experiment Station is discovering and creating new knowledge and technology in the field of natural resources and conveying this information to the people who can use it. As a new generation of forests emerges in our region, managers are confronted with two unique challenges: (1) Dealing with the great diversity in composition, quality, and ownership of the forests, and (2) Reconciling the conflicting demands of the people who use them. Helping the forest manager meet these challenges while protecting the environment is what research at North Central is all about.

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